



Developing a Low Carbon Future through EdTech Tools

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by Abigail Williams.

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1. Introduction

1.1 Background

We have entered an age where it is imperative that the climate crisis is no longer questioned, but responded to. Debate will still dominate the subject, however this will cease to be whether such a crisis exists, but rather how it should be addressed. We have been privileged to begin the 2020s with large-scale, international climate strikes led by students of many ages, who understand that their future is threatened, and insist that we should ‘panic like our house is on fire’ (Thunberg, 2019). A 1-degree rise in global temperature has seen increased devastating natural events such as storms, forest fires, droughts, floods and heat waves (Chou and Feng, 2018). A 1.5-degree rise may put 20-30% of species at risk of extinction (Smith et al, 2018). There are many different contributing factors to the release of greenhouse gases, which must be ubiquitously addressed in order to slow the trend of global warming.

This thesis has been completed in partnership with Liverpool’s first hydroponic farm, Farm Urban and the social enterprise EcoVerse, who exist to problem solve regarding the unsustainability of our current methods of agriculture. Overuse of fertilisers has caused eutrophication, impacting many different biomes (Withers et al, 2014), soil is eroding at a rate of 20-100 times faster than it can be formed (Kaushik, 2004), and huge amounts of energy are required to process, store and transport food (Walker et al, 2017). Additionally, the vast amount of land, water and fossil fuels used for animal agriculture will not be sustainable to scale farming to feed a growing global population (Van Kernebeek, 2016). Farm Urban and EcoVerse both work with communities, and in particular schools, to raise awareness about the climate crisis and food insecurity, whilst Farm Urban additionally innovates ways of growing food sustainably. This research has contributed to the development of EcoVerse’s Education Technology (EdTech) tool, which will deliver information to students about scientific progress as it happens.

The research question identified that this thesis seeks to answer is:

Can environmental education be successfully facilitated through an EdTech tool to build a low carbon future?

1.2 Farm Urban

Food growing

Farm Urban Ltd was founded to research alternative methods of agriculture in urban areas. The organisation has experimented with different systems and spaces, including a rooftop aquaponic system, which grows fish and plants together, and hydroponic and aeroponic systems, where plant roots are suspended in running water or a mist of water (Farm Urban, 2020). Aquaponic farming removes the need for petrochemical fertilisers, as it is the fish waste that provides ammonia for the plants growing above (Joyce, A. 2019). Hydroponic and aeroponic methods have the potential to reduce the

need for space as the towers in which plants are grown are vertical and the water required is reduced, as recycled water is used (Kalantari, 2018).

These urban farming methods are of great relevance to the climate crisis for a number of reasons. Firstly, by growing food in urban areas the extensive carbon footprint of transporting food is reduced drastically, and fresh food can be delivered by environmentally friendly means such as walking or cycling (Kulak et al, 2013). Secondly, by growing food in a controlled environment in an indoor space, food growing is not dependent on seasonal variables, which are likely to become inconsistent and erratic throughout the climate crisis (Benke and Tomkins, 2018). Finally, using all available urban space dramatically reduces the area needed to grow food. This could include basements and rooftops of industrial buildings, or having smaller systems in homes.

There are significant challenges in establishing the economic and environmental feasibility of vertical farms (Banergee, 2014). There are many reasons for the failures of previous unsuccessful ventures in urban farming, however a particular issue of relevance to this thesis has included the lack of a large enough skilled workforce (Carlisle et al, 2019). To farm using methods such as hydroponics involves teams with varied skill sets (Wortman and Lovell, 2013). At the very least, an understanding of bioscience, engineering and botany must be entrenched, alongside the business acumen required to embark upon the new venture and a high level of computer literacy across the board. Farm Urban's hydroponic farm is based in the crypt of a building, which also hosts a high school. Through a successful partnership with Liverpool Life Sciences, Farm Urban have developed their education and outreach offer, in order to engage and inspire the vertical farming technicians of the future (Liverpool Life Sciences UTC, 2020).

Naturally, vertical farming is only one potential solution to the unsustainability of food growing, and there must be innovation across agriculture in all of its forms across the world to promote the resilience of global food systems. However, it is beyond the scope of this thesis to explore solutions outside of vertical farming, as this research primarily focuses on the development of an EdTech tool, using vertical farming as a case study.

Education

Farm Urban began developing their education programme by offering workshops to make urban farming more accessible for the local community (Farm Urban, 2020). Having built their own aquaponics system from basic plumbing parts and Ikea boxes, they challenged participants of various ages and backgrounds to attempt to build their own small scale system using only the materials that could be found in the box in front of them and no instructions. Farm Urban began to work with Liverpool Life Sciences School to encourage students to become involved in their research. Together, the Farm Urban team and a group of Sixth Form students designed and built a striking double helix aquaponics system to sit in the entrance of their school (Farm Urban, 2014).

The success of joint working with the school led Farm Urban to develop the Future Food Challenge, which was piloted in 2017. The challenge enabled 150 year nine

students, from ten Merseyside schools, to compete in creating their own start-up business, and create a functioning prototype aquaponics system (University of Liverpool, 2018). The programme ran as an after school Science, Technology, Engineering and Maths (STEM) programme. After a launch day based at the University of Liverpool Engineering Department, the twelve-week programme took place in each individual school, facilitated by a teacher and remote support from Farm Urban. Content for the programme was provided via a basic website, with weekly slideshows and resources, materials for the prototype system were delivered by Farm Urban, and the 12 week programme was completed with a competition day at Farm Urban’s learning laboratory, at which each school presented their business and aquaponics system to a panel of judges.

The first Future Food Challenge was independently evaluated through the University of Liverpool. The evaluation determined that the programme had been successful and that there was much scope to develop the programme further. Farm Urban CIO was established to take forward Farm Urban’s education programmes and also to focus on other social impact elements to food growing. For example, Farm Urban CIO has secured funding to provide fresh greens to schools and residents of housing association groups in Liverpool. Farm Urban saw the potential of their Future Food Challenge to be delivered through an online platform, however feeling that this was outside of Farm Urban’s remit, a new social enterprise, EcoVerse was established to move further into education and develop an EdTech tool. Whilst EcoVerse will host the Future Food Challenge as it’s pilot programme, it is envisaged that EcoVerse will work with many organisations working with low carbon technology to host further educational content. Subsequently, EcoVerse secured funding and began to work in partnership with the Web Developers IG00 to develop the first iteration of an online platform. EcoVerse also received funding from the Low Carbon Eco-Innovatory, to enable research to be conducted for ‘developing a low-carbon future through EdTech tools’, the title of this thesis.

Figure 1 summarises the structure of Farm Urban Ltd, Farm Urban CIO and EcoVerse.

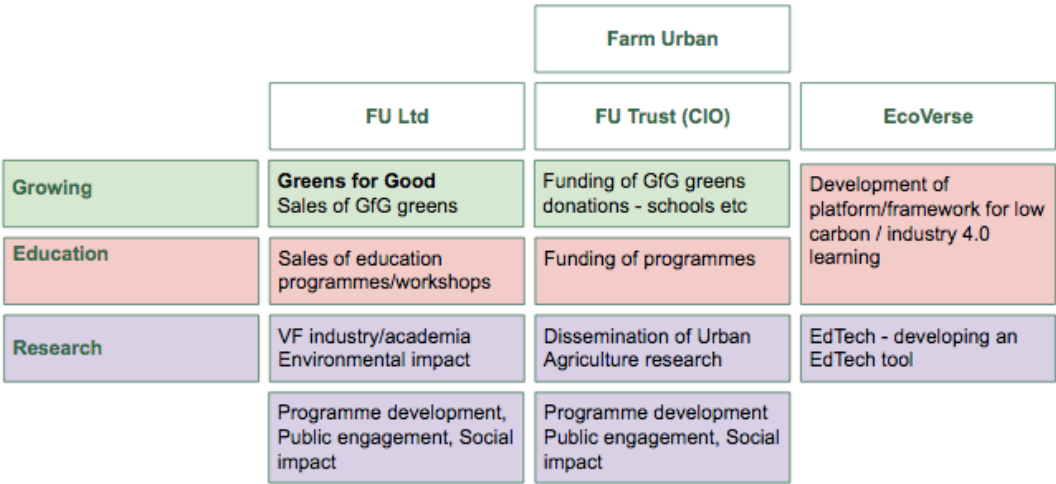


Figure 1

The work of Farm Urban Ltd provides the context for this thesis, as growing food sustainably is the low carbon technology that this research is focussed on. However, two elements of Farm Urban's structure that are of note for this research are Farm Urban CIO's education programme, the Future Food Challenge, and EcoVerse's EdTech Tool, the EcoVerse platform. This thesis outlines how the EcoVerse platform has been developed in order to host low carbon educational content, such as the Future Food Challenge, to scale educational programmes for the low carbon industry. The intention of making such programmes available for many more participants is to encourage the development of the skills required to work in low carbon industries, and to raise the profile of such industries as an available career pathway.

1.3 Education Technology

EdTech is any technological application to support or enable learning (Department for Education, 2019). In 2019, the UK Government launched its first EdTech strategy, recognising that following the fourth industrial revolution, the skill sets that students must develop to live and work in an automated age are different to the skills of their predecessors. EdTech is in its infancy in UK schools, and efforts in this field have predominantly been led by industry. According to Nesta, an innovation foundation, whilst some impressive progress has been made, this has also resulted in some disjointed development. This is through a lack of partnership working, as some excellent products will not function in schools, where the technological capability lags behind that of the private sector. (Nesta, 2019). The Nesta Conference 2019 called for more education test-beds to enable industrial partners and educators to work together to develop viable educational products (Nesta, 2019). Farm Urban is well placed to enact such a test-bed through its partnership and co-location with Liverpool Life Sciences School, in addition to its partners through the Future Food Challenge.

EcoVerse will serve as a host platform, providing content, interactive activity and engagement with industry 4.0 technology to inspire and equip students to build a low carbon future. The remit of this Masters research has been to provide research and development for the EcoVerse EdTech tool. An iterative approach to the development of the product was natural, as a Minimum Viable Product, a website, had already been established and tested during the first Future Food Challenge, as well as an independent evaluation of the existing programme. My research has therefore been to: gain a wider knowledge of the UK landscape for EdTech; understand the beliefs and values of key stakeholders to consolidate the design concept for the product; gather data from key partners to understand barriers to using EdTech and to work with all agencies in an holistic manner to see the completion of the first iteration of an EdTech tool.

The completion of the online platform will allow a sound basis for further development of the product. There is scope for this EdTech tool to host varying content relating to low carbon technologies, for example, to use sensors in order to monitor plant growth and nutrient management and for artificial intelligence to be used in order to self-generate FAQ answers on the platform.

The purpose of this endeavour is to contribute to the network of international knowledge enabling us to build a low carbon future.

1.4 Methodology

For this research an ‘Action Research’ methodology was implemented, whereby a literature review was completed, relevant conferences attended and data was collected, whilst simultaneously developing content for the EdTech tool. Simultaneously, partnership was developed with web developers, IGOO, to understand the journey of a project participant to enable the online platform to be as accessible as possible.

The researcher volunteered with Farm Urban for two months before commencing the research, to become familiarised with the Future Food Challenge, watching Farm Urban deliver ‘TEDx talks’ about food sustainability in schools and helping with the delivery of workshops. In delivering ‘TEDx Talks’ to schools across Merseyside, Farm Urban gathered approximately 1,200 feedback forms from students, and students granted permission to share their answers with the University of Liverpool. Through volunteering with Farm Urban, the beliefs and motivations of the stakeholders who have worked in partnership for the development of this project were explored. The research question, ‘Can environmental education be successfully facilitated through an EdTech tool to build a low carbon future?’ was broken down into sub-areas. This resulted in the following questions, which were considered throughout this MPhil:

1. To what extent do educational stakeholders prioritise environmental education in Merseyside schools?
2. What pedagogical methods have been used successfully to equip students to build a low carbon future?
3. What are the barriers to providing environmental education in Merseyside schools?
4. How is EdTech currently used to provide solutions for educational aims?
5. How can EcoVerse’s online platform be effectively developed to equip Merseyside’s students to solve future food problems?

An Action Research approach was taken for data collection throughout this project. After initially undertaking a literature review, three cycles of research were conducted:

Cycle 1:

- Read the independent evaluation reports of Farm Urban’s pilot Future Food Challenge.
- Volunteer with Farm Urban and EcoVerse to understand the vision, mission and values of both organisations.
- Establish a theoretical framework for product development.

Cycle 2:

- Observe the delivery of the Future Food challenge.
- Develop further resources according to the theoretical framework.
- Determine the required user journeys of participants using the online platform.
- Map the existing Future Food Challenge onto a potential online platform for assessment and development by IGOO.

Cycle 3:

- Observe the delivery of the Future Food Challenge using the EcoVerse platform.
- Collect feedback from participants throughout the programme.
- Conduct teacher interviews.

Unfortunately the third cycle of research could not be completed as a result of the COVID-19 pandemic, which necessitated the closure of UK schools. The use of TEDx talk feedback forms had previously been considered, as this was an extensive dataset with valuable information about student responses to a talk about food insecurity. Initially, this dataset had been ruled out due to time constraints, as data was being gathered from students regarding their experience of using the EcoVerse platform. However, as it was not possible to collect the latter due to the cancellation of the Future Food Challenge as a result of the pandemic, the TEDx feedback was revisited as a useful dataset, which is of direct relevance to the product development of the EcoVerse platform. Therefore, the TEDx talk data that was gathered in Autumn 2019 was processed and interviews were conducted with teachers who had facilitated the Future Food Challenge in previous years.

The TEDx talk feedback was gathered through a questionnaire that included both qualitative and quantitative data gathering methods. The open boxes for students to fill out answers to questions were useful, as many students were unfamiliar with the subject matter, which explored the use of aquaponics, a relatively new technology. Likert scales were also provided for students to rank their agreement with statements from the talk. This mixed methods approach was useful in establishing whether there was mutual corroboration between the qualitative and quantitative responses (Mertens and Hesse-Beiber, 2012).

Qualitative research methods were also used to explore the use of EdTech for raising environmental awareness and skill development through interviews with teachers who had facilitated the programme. Consideration was made of how the EdTech tool could meet the needs of students and teachers to equip them to engage in low carbon behaviour, and how teachers could further use the tool to inspire students to utilise their skills to innovate low carbon technologies. As it was only possible to conduct a small number of interviews, a qualitative approach was suitable for the sample size.

1.5 Data Analysis

The qualitative and quantitative data was collected and analysed using the following processes:

- 1) With a basis in Grounded Theory, an inductive analysis on the qualitative answers provided on the TEDx talk feedback forms was completed. After processing the raw data, line-by-line coding was conducted using NVivo software, to generate codes according to the emergent themes. Codes were reviewed and refined to complete axial and selective coding.
- 2) Likert Scales were processed from the raw data and reviewed, to complete a basic analysis to understand how students had responded to four aspects of the talk as outlined within the statements.

- 3) Interviews with teachers were conducted and transcribed, and a thematic analysis was completed. In vivo coding of the transcripts using NVivo software was undertaken, to understand the similarities and differences within teachers' views of the topics as outlined in the theoretical framework.

The analysis of the data has enabled me to contribute research that explores the attitudes of Merseyside students and teachers to environmental education. The analysis aided the production of a methodological framework to guide future iterations of the EcoVerse tool, and consider the threats and opportunities for further scaling of the product.

1.6 Summary

The aim of this research has been to develop an EdTech tool to equip students to find solutions to lower carbon emissions and develop skills for their future. Data was collected to understand students' and relevant stakeholders' beliefs about sustainable food production and the required skillsets. Due to the COVID-19 pandemic, the Future Food Challenge 2019-20, which is the first programme to be hosted on the EcoVerse platform, was cancelled. It was therefore not possible to collect data to understand user experience of using the platform, and how successfully the EcoVerse platform facilitated environmental education. However, in partnership with teachers and Farm Urban, EcoVerse's prototype EdTech product was developed and is ready to be piloted. A theoretical framework was developed to understand how to create the conditions for students to exhibit an action response to environmental education, and a methodological framework was designed to provide a basis for the expansion of the EcoVerse tool for additional low carbon technologies and audiences. The thesis therefore used a two-pronged approach in using the revised data collection plan to conceptually explore the facilitation of environmental education in Merseyside, and apply the insight gained to the development of the EcoVerse platform and plans for its further development, therefore meeting the project brief for this research.

1.7 References

- Banergee, C., (2014), 'Up, Up and Away! The Economics of Vertical Farming', *Journal of Agricultural Studies*, 2(1), pp. 40-60.
- Benke, K., and Tomkins, B., (2018) 'Future food-production systems: vertical farming and controlled environment agriculture', *Sustainability: science, practice and policy*, 13(1), pp. 13-26.
- A. Bryman, *Social Research Methods*, Fourth Edition, (2012), *Oxford University Press*
- Carlisle, L., Montenegro de Wilt, M., DeLonge, M., Iles, A., Calo, A., Getz, C., Ory, J., Munden-Dixon, K., Galt, R., Melone, B., Knox, R. and Press, D., (2019), 'Transitioning to Sustainable Agriculture Requires Growing and Sustaining an Ecologically Skilled Workforce', *Frontiers in Sustainable Food Systems*, <https://doi.org/10.3389/fsufs.2019.00096>
- Chao, Q. and Feng, A., (2018) 'Scientific Basis of Climate Change and its response', *Global Energy Interconnection*, 1(4), pp. 420-427.
- Department for Education (2019), 'Realising the Potential of Technology in Education: a strategy for education providers and the technology industry', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/791931/DfE-Education_Technology_Strategy.pdf, (accessed on 3 September 2019)
- Farm Urban (2014), available at <https://farmurban.co.uk/the-worlds-first-aquaponic-double-helix/>, accessed (13 September 2019)
- Farm Urban (2020), available at <https://farmurban.co.uk/about/>, (accessed on 10 September 2019)
- Farm Urban (2020), available at <https://farmurban.co.uk/workshops/>, (accessed 3 July 2020)
- Joyce, A., Goddek, S., Kotzen, B. and Wuertz, S., (2019) 'Aquaponics: Closing the cycle on limited water, land and nutrient resources' *Aquaponics Food Production Systems : Combined Aquaculture and Hydroponic Production Technologies for the Future* (Springer International Publishing), 2019. Pp. 19-34.
- Kalantari, F., Tahir, O., Joni, R., Fatemi, E., (2018) 'Opportunities and challenges in sustainability of vertical farming: a review', *Journal of Landscape Ecology*. 11(1) pp. 35-60.
- Kaushik, A. (2004) *Perspectives in Environmental Studies*, New Delhi: New Age International (P) Ltd.
- Liverpool Life Science UTC (2020), available at <https://lifesciencesutc.co.uk/what-we-do/extra-curricular-and-enrichment/>, (accessed on 3 July 2020)

Nesta (2019), 'EdTech companies called on to tackle challenges facing the education system', available at <https://www.nesta.org.uk/press-release/edtech-companies-called-tackle-challenges-facing-education-system/>, (accessed on 3 July 2020)

Mertens, D. and Hesse-Biber, S., (2012) 'Triangulation and Mixed Methods Research: Provocative Positions', *Journal of Mixed Methods Research*, 6(2).

Nesta (2019), 'Testing innovation in the real world', available at <https://www.nesta.org.uk/report/testing-innovation-real-world/>, (accessed 3 July 2020)

Smith, P. Price, J., Molotoks, A., Warren, R. and Malhi, Y. (2018) 'Impacts on terrestrial biodiversity of moving from a 2°C to a 1.5°C target'. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376(2119), pp. 1 -18

Thunberg, G., (2019), 'Our house is on fire': Greta Thunberg, 16, urges leaders to act on climate' *The Guardian*, 25 January 2019.

University of Liverpool (2018), available at <https://news.liverpool.ac.uk/2018/09/06/local-schools-take-on-future-food-challenge/>, (accessed on 3 July 2020)

Van Kernebeek, H., Oosting, S.J., Ittersum, van, M.K., Bikker, P. and Boer, de, I.J.M., (2016) 'Saving land to feed a growing population: consequences for consumption of crop and livestock products', *The International Journal of Life Cycle Assessment*. 21(5) pp. 677-687

Wortman, S. and Lovell, S., (2013) 'Environmental Challenges Threatening the Growth of Urban Agriculture in the United States', *Journal of Environmental Quality*, 42(5), pp.1283 - 1294.

Walker, C., Beretta, C., Sanjuán, N. and Hellweg, S., (2018) 'Calculating the energy and water use in food processing and assessing the resulting impacts' *international journal of life cycle assessment*, 23(4), pp. 824-839.

Withers, P., Neal, C., Jarvie, H. and Doody, D., (2014) 'Agriculture and Eutrophication: Where do we go from here?' *Sustainability*, 6(9) pp. 5853-5875.

2. Literature Review: Imagining a Low Carbon Future

2.1 Introduction

This chapter will explore three aspects of building a low carbon future; present practices, which lead to carbon emissions; human response to the climate crisis; and suggested answers for building a low carbon future. This thesis theorises that in order to substantially lower carbon emissions, every member of society must be aware of what the issues are, and be equipped to understand the role that we can play in addressing the climate crisis. This is particularly true of young people, whose future will be largely shaped by the changes that the climate crisis brings.

It is evident that there is a complex network of intersecting factors, which have resulted in the climate crisis, which we cannot hope to explore in any detail within the remit of this thesis. This chapter will therefore focus on the role of agriculture in releasing carbon emissions, as this is of the most relevance to this thesis. Similarly, though of course the climate crisis is a global issue, the chapter will focus on the UK context for carbon reduction, as this EdTech tool has been piloted within UK schools. Whilst there has been interest in the product from international schools, for example, in the USA and UAE, further research would need to be undertaken for an international audience.

In searching for literature regarding this subject, I have started by following recommendations from papers and colleagues to understand the voices of the most pre-eminent researchers in the field. I have tracked the references, which are most often cited to understand the most influential literature in the area that I am studying. I have additionally sought further information using the University of Liverpool's library and journal search engine using the keywords 'low carbon', 'zero carbon', 'climate crisis', 'agriculture emissions', 'aquaponics', 'hydroponics' and 'sustainable farming methods'. This returned a wealth of information, and articles were chosen based on the following search criteria:

- a. Relevance to the UK context
- b. Study limited to the last ten years (with exceptions based on relevance)
- c. Focus on agriculture

2.2 The climate crisis and UK history

Developing an EdTech tool to contribute to developing a low carbon future must be a holistic exercise. Through understanding the history of how within two centuries we have seen such a dangerous increase in greenhouse emissions, we can see how intertwined carbon usage is with our political and economic systems, our livelihoods and our leisure activities. Simply put, creating a low carbon future means unpicking the way that human activity is so deeply enmeshed in the use of carbon.

Human activity has impacted the natural environment for millennia, from deforestation for expanding civilisations to the release of methane from rice production for the past 5,000 years (O'Brien, 2018). Having previously been reliant on energy from the sun that had been stored for little longer than a year, for example

in plants through photosynthesis, the discovery of fossil fuels, initially coal, led to the dawning of the first industrial revolution (Wrigley, 2013). The industrial revolution enabled much of British infrastructure, as we know it, to be created. Energy through the use of coal allowed faster transport networks through steam trains, an alternative way of heating our homes and lighting for home and work spaces (Fouquet, 2014). There was some early recognition of the way in which the increasing amount of carbon dioxide released into the atmosphere may result in global warming. For example, by the end of the nineteenth century, chemists such as Arrhenius had identified modern industry as the main supplier of carbonic acid to the atmosphere, and calculated the potential effect of increased carbonic acid in the atmosphere on global temperature (Arrhenius, 1896). There was a dispute amongst scientists through the early twentieth century concerning the absorption of carbon dioxide by other means, and therefore the resultant potential for temperature change, however, by the 1970s, it was largely accepted that global temperatures would rise as the concentration of CO₂ in the atmosphere increased (Zhong and Haigh, 2013).

Following the industrial revolution, our political, economic and social systems were intrinsically linked to energy (Fouquet, 2014). Progress, in the West, became synonymous with growth, however 'growth' was largely espoused in terms of economic and industrial growth, to the exclusion of natural, social, and cultural capital (Jackson, 2013). The economy of energy became entrenched in international trade, and the establishment of these practices was based on a view that the transaction of fossil fuels was a closed affair between consumer and buyer and therefore price was not affected by the consideration of the environmental price of the activity (Allen et al, 2013).

Resources were treated as infinite, and therefore an entire way of life was built around our dependence upon coal, oil and gas. Economic success was linked to our access to fossil fuels, wars were fought to ensure that supplies were maintained and the British public, alongside the rest of the world increasingly, became accustomed to the comforts that our dependence awarded us. Our understanding of what our basic needs are was reimagined.

A well-known tool for understanding human needs was articulated by Maslow, who asserted that there was a 'hierarchy of needs'. This ranged from basic needs such as food, water and shelter, which formed the bottom of a pyramid demonstrating the hierarchy, through to psycho-social needs, proposing the final need of self-actualisation (Datta, 2010). Throughout the twentieth century, as life expectancy in the UK began to extend and the basic needs outlined in Maslow's hierarchy were largely met for a significant part of the population, the perception of what we 'need' began to change, moving expectations of our entitlements up the hierarchy (Pasten and Carlos, 2012).

For many, food means to have all desired food available at all times of the year in a processed form. We have fresh, seemingly infinite water at the turn of a tap. Shelter has expanded to encompass larger spaces, with electricity and heating. Many feel that to own a vehicle is a need, as it is required to access employment, which is particularly understandable for those with physical needs making walking difficult or impossible. We need a communication infrastructure to access emergency assistance such as the police or an ambulance. Throughout the 21st Century, we have been

increasingly reliant on technology to fulfil the requirements of our education, our employment, to pay our bills and to access our money. Such daily needs, as listed, are intertwined seemingly inextricably with the use of carbon – from high levels of CO₂ emitted to produce fertiliser for our crops, to the energy consumption of domestic media and IT (Razon, 2014; Bates et al, 2014).

2.3 The UK's carbon budget

Environmentally, the industrial revolution had dire consequences for the planet. However the rapid scientific discovery that it awarded provided the UK with wealth and knowledge allowing rapid medical advancement and for many, longer lives without the fear of starvation or a lack of access to basic provision (Pasten and Santamarina, 2012). Through the UK's colonial expansion, resources and wealth were created at the cost of indigenous populations across the world (Allen et al, 2013).

Due to the fact that 'Western' countries have already benefited from their use of carbon, it is considered that they have a much smaller carbon budget remaining than developing countries as countries seek to move towards net carbon zero domestic and industrial practices (Yedla and Garg, 2014). For the UK to remain within its carbon budget, assuming a population of 70 million between now and 2050, the UK would be required to emit less than 8,400 MtCO₂e for an 80% chance of avoiding a 2°C temperature rise and 14,000 MtCO₂e for a 50% chance. According to current UK policy targets and international commitments, the UK will emit 16,000 MtCO₂e (Allen et al, 2013).

It is evident therefore that there must be dramatic change to UK policy and action to meet the current emission requirements for an 80% chance of preventing a 2°C temperature rise. However, these projections do not consider other factors that will contribute to a rise in temperature. For example, as deforestation increases and more ocean dead zones develop, the amount of plants and trees currently acting as carbon sinks will reduce, resulting in a higher rate of carbon emission into the atmosphere (Weindl et al, 2017). As climate change occurs, there will undoubtedly be unforeseen factors, which will affect the rate of carbon release, which are not necessarily factored into a calculation for carbon reduction targets. As such, even greater emission reduction needs to be aspired to, to offset the dangers from a global temperature rise.

2.4 International Cooperation

The UK, as a member of the European Union, has ratified several international treaties and agreements. Figure 2 from the Intergovernmental Panel on Climate Change outlines the structure of the majority of climate agreements:

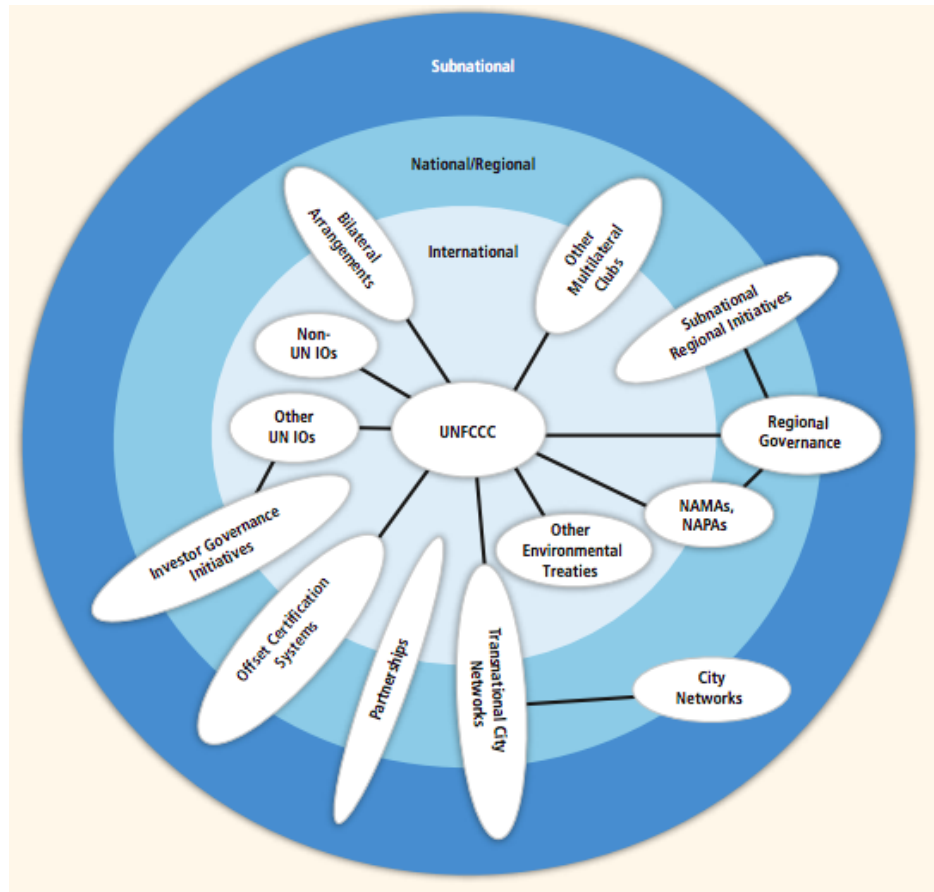


Figure 2 (Stavins et al, 2014)

The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 with the aim of stabilising greenhouse gas concentrations in the atmosphere (International Institute for Sustainable Development, 2013). From the UNFCCC, a number of other groups and conferences have been held, resulting in further agreements. Two agreements of note include the Kyoto Protocol, the first binding environmental agreement under international law, and the Paris Agreement. The Kyoto Protocol outlined two stages of the commitment, between 2008-2012 and 2013 to 2020, however the second stage of the agreement received significantly less support than the first (McPherson, 2012). The Paris agreement saw 196 parties commit to carbon reduction measures, however the US notably removed support from the agreement in 2017 (United Nations Treaty Collection, 2020; Lavanya and Jutta, 2017).

Under the Kyoto Protocol, the UK agreed to a 12.5% reduction on base year emissions, and in 2014, the UK confirmed that it had met its carbon budget requirement (Department for Energy and Climate, 2015). Under the Paris Agreement, the UK agreed as a member of the EU to a 40% reduction in emissions below 1990 levels by 2030 (European Commission, 2020). The UK has also enacted its own legislation to address climate change. The Climate Change Act 2008 stipulates that the UK must reduce its emissions to at least 100% of the 1990 baseline (UK Government, 2020).

2.5 Policy and Activism

There have been different movements relating to global sustainability across the past century, however climate activism from scientists and grassroots movements since 2016 have resulted in the first local and national governmental declarations of a 'climate emergency', (Climate Emergency Declaration, 2020). Some examples of activism, which have resulted in governmental action, have included media attention being given to Greta Thunberg, a Swedish activist who started striking from school each Friday in 2018 to sit outside the Swedish Parliamentary building to challenge her government to act in response to the climate crisis. It estimated that by 19th March 2019, 1.4 million students joined the strike, representing over 120 countries (Boulianne et al, 2020).

Another group whose activity has attracted increasing attention is Extinction Rebellion, which launched in 2018 as a non-violent, civil disobedience movement to cause structural change to address climate change. It's three core demands are for the UK government to be transparent about the issue of climate change and declare an emergency, to achieve net-zero carbon emissions by 2025, and for there to be a citizens assembly to ensure that the UK moves towards a system of climate justice (Westwella and Bunting, 2020).

One such aim became a reality when the UK government declared a climate emergency on 1st May 2019, following the decision of many local councils, led by Bristol, to do so (Bristol City Council, 2018; BBC, 2019). Such a declaration means a government commits itself to tackling climate change as a priority issue, and therefore environmental concerns are likely to influence other policy decisions in a way that they have not previously done so. This decision was an acceptance that the aims under the Climate Change Act were not realistically to be achieved without significant change of governmental policy backed by investment (Ghag, 2019). Naturally, these movements were not the first groups to campaign for environmental justice - many well established charities have campaigned long term for global sustainability. However, it could be said that in 2019, the joining together of youth activism, new grassroots movements and scientific consensus combined at the right time internationally to ensure that governments were forced to react to high public pressure for a strategic plan to address climate change.

Liverpool City Council represents the area for which this research was conducted. In 2018, the mayor's office announced its 'Inclusive Growth Plan', which announced steps towards environmental protection. The plan claimed to promote 'environmentally friendly modes of transport' and additionally that the council would be 'working with schools to increase understanding and engagement in protecting the environment' (Mayor of Liverpool, 2018). On 17th July 2019, Liverpool City Council declared a climate emergency, stating that 'Liverpool Council recognises that we should not wait for national government to change its priorities or policies'. The council outlined that its aim is to become net zero carbon by 2030 (Liverpool City Council, 2019). Some immediate steps taken by the council have included; installing LED lights across the city; committing to plant 4,000 more trees; recycling of illegally dumped metal, and planning for green spaces in the city. Liverpool, like other local authority areas, is limited in their capacity to institute changes due to the

severe budget cuts that have taken place over the last decade (Liverpool City Council, 2019).

2.6 Planetary boundaries

To make steps towards global sustainability, many issues must be addressed simultaneously. The Stockholm Resilience Centre have outlined 10 ‘planetary boundaries’ as demonstrated in figure 3:

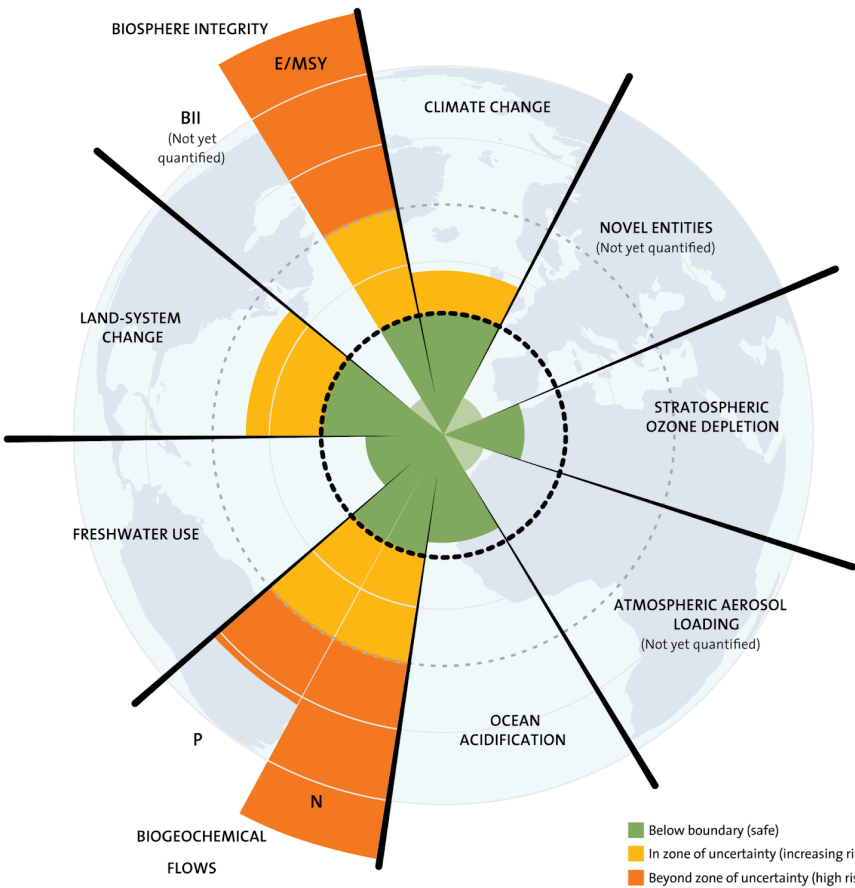


Figure 3 (Stockholm Resilience Centre, 2020)

As the planetary boundaries indicate, there are many boundaries that relate directly to current agricultural practices. These are detailed in the table 1:

Planetary boundary	Issues contributed by agriculture
Climate Change	<ul style="list-style-type: none"> • Transport of food around the world contributing to greenhouse emissions • Heavy energy use from the Haber Process to create fertilisers
Biodiversity	<ul style="list-style-type: none"> • Deforestation resulting in destroyed habitats for agricultural

	<ul style="list-style-type: none"> land • GHG causing climate change resulting in elimination of habitats
Biochemical flows	<ul style="list-style-type: none"> • Overuse of fertilisers cause nitrogen and phosphorus run off, which pollutes freshwater and kills aquatic life • Pollution from chemical run offs can affect ecosystems and therefore food chains
Freshwater use	<ul style="list-style-type: none"> • Much of the world's freshwater supply is used for agriculture
Land-system change	<ul style="list-style-type: none"> • Deforestation and intensely grazed grassland limits land use as a climate regulator e.g. the absorption of CO₂

Table 1 (Allen et al, 2020)

It is important that students are aware of the multifaceted interactions between human activities within ecosystems, to understand the complexity of environmental issues. For example, as demonstrated by table 1, to address land system change, students must first understand the way in which we use land, the conventional farming methods used, and the food choices made by individuals. Each planetary boundary is in relationship with other planetary boundaries, and all are affected by human activity, shaped by laws, cultures, international relations, industry, media and more.

2.7 New Technologies in Urban Farming

Evidently, there are numerous ways in which our conventional farming methods contribute to the exceeding of planetary boundaries, and we must seek more sustainable farming methods. This thesis considers growing plants in water in urban areas as one aspect of sustainable farming. Aquaponics combines the use of aquaculture, which is to farm fish, with the practice of growing plants in water, which is described as hydroponics (Kyaw and Keong Ng, 2017). Aquaponics reduces the need for manufactured chemical fertilisers, as nitrifying bacteria is used to breakdown ammonia from fish waste into nitrate, which plants use for protein production (Joyce, 2019). Hydroponic farming still requires the use of fertiliser, but has other benefits such as the ability to grow food in vertically stacked systems, reducing the need for space.

Both methods, which can grow food indoors, allow for food to be grown in a controlled climate. This removes the potential for failure of crops due to poor weather conditions (Tomlinson, 2015). Farm Urban, a social enterprise in Liverpool, UK, constructed the city's first hydroponic farm in 2019. By utilising disused space in the city centre, Farm Urban's basis for establishing the farm is that leafy greens can be grown and delivered locally, reducing pollution from food miles, and keeping food fresher (Farm Urban, 2020).

There are, of course, disadvantages to aquaponic and hydroponic farming methods. The cost of constructing and maintaining urban farms using these methods is high, and many aquaponic and hydroponic farms have not been able to maintain a financially sustainable business. The most significant costs can include labour, electricity and feed costs, however economic studies have demonstrated that it is

feasible to have a financially viable farm (Rodrigo et al, 2020). The high level of energy required for LED lights to grow crops also calls into question the environmental benefits of using the systems, however increasingly, farms are attempting to use renewable energy production methods (Tomlinson, 2015).

Undoubtedly, there are both advantages and disadvantages to urban farming methods, which cannot be explored further within the remit of this thesis. However, as a potential viable method of enhancing food production in the UK, which requires further research and innovation, this thesis will focus on Farm Urban's educational material surrounding the use of aquaponic farming as the first programme to be hosted by the EcoVerse EdTech tool.

2.8 Summary

The UK's series of industrial revolutions, whilst resulting in a myriad of positive effects for humankind, has had wide reaching, and often negative, implications on the environment, largely through practices that release greenhouse gases. Whilst various scientists have published data to suggest that the accumulation of greenhouse gases in the atmosphere could result in a rise in global temperature, which could lead to catastrophic climate change, for over a century, we have only recently seen a shift in UK policy, law, and public perception of the protection of the environment as a priority issue. British students must be equipped with knowledge of the UK's carbon history and international cooperation, to contribute meaningfully to discourse for the future. This is particularly relevant for the UK as it separates from the European Union, and must establish its independent position internationally on how the country will become zero carbon.

Human activity is intertwined with our use of energy, which since the industrial revolution has predominantly been derived from fossil fuels, resulting in greenhouse gas emissions. One of the largest contributors of carbon emissions through its activity is the food industry, through its management of livestock, deforestation to clear space for grazing, and energy intensive processes for the production of fertiliser, amongst other carbon emissions relating to food production.

Through a partnership with the Liverpool based hydroponic farm, Farm Urban, EcoVerse has been developed as an online platform to contextualise the climate crisis, and break down the issues into smaller, interdisciplinary modules for students to begin to holistically engage with the issues. EcoVerse will provide a platform on which different modules can sit, to allow schools and students to engage with different concepts around environmental health. The product design breaks down disciplinary silos, and allows students to view the environment through the different lenses required to problem solve, for example, biological sciences, engineering, botany, law, media and communications, amongst others.

In the next chapter, the way in which environmental education is taught, or omitted, in the UK is explored further.

2.9 References

- Allen, P., Blake, L., Harper, P., Hooker-Stroud, A., James, P. and Kellner, T. (2013) *Zero Carbon Britain: Rethinking the future*, Aberystwyth: CAT Publications, pp. 1-26.
- Arrhenius, S., (1896), 'On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground', *Philosophical Magazine and Journal of Science*, 41(5), pp. 237-276.
- Bates, O., Hazas, M., Friday, A., Morley, J., and Clear, A., (2014) 'Towards an holistic view of the energy and environmental impacts of domestic media and IT', *Human Factors in Computing Systems*, pp. 1173-1182.
- BBC News (2019), 'UK Parliament declares climate change emergency', available at: <https://www.bbc.co.uk/news/uk-politics-48126677> (accessed on 3 July 2020).
- Bristol City Council (2018), 'Bristol City Council Mayor's Climate Emergency Action Plan 2019', available at: <https://www.bristol.gov.uk/documents/20182/33379/Mayor%27s+Climate+Emergency+Action+Plan+2019+FINAL> (accessed on 5 July 2020).
- Climate Emergency Declaration (2020), 'Climate emergency declarations in 1,737 jurisdictions and local governments cover 820 million citizens', available at: <https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/>, (accessed on 4 July 2020).
- Datta, Y. (2010) 'Maslow's hierarchy of basic needs: an ecological view' *Oxford Journal* Vol. 9 (1), pp. 39-57.
- Department for Energy and Climate Change (2015), 'UK progress towards GHG emission reduction targets', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/414241/20150319_Progress_to_emissions_reductions_targets_final.pdf, (accessed on 25 April 2020).
- European Commission, (2020) 'Paris Agreement', available at: https://ec.europa.eu/clima/policies/international/negotiations/paris_en, (accessed on 3 July 2020)
- Farm Urban, (2020), 'Greens for Good', available at <https://www.greensforgood.co.uk/>, accessed on 6 September 2020.
- Fouquet, R., (2014) 'Long-Run Demand for Energy Services: Income and Price Elasticities over Two Hundred Years', *Review of Environmental Economics & Policy*. 8(2), pp. 186-207.

Ghag, J., 'A ticking time bomb? Liverpool declares a climate emergency: What next?' (2019), *Environmental Law Review*, 21(3) pp. 169-171.

International Institute for Sustainable Development, (2013), 'A brief history of the UNFCCC and the Kyoto Protocol', *Earth Negotiations Bulletin*, 12(580), pp. 1-3.

Jackson, T., (2013) *Building a Sustainable and Desirable Economy-in-Society-in-Nature*
Canberra ANU: Press 2013.

Jung, J., Petkanic, P., Nan, D., Kim, J. (2020), 'When a girl awakened the world: A user and social message analysis of greta thunberg' *Sustainability* 12 (7), pp. 1-17.

Kyaw, T. Y. and Ng, A. K. (2017) 'Smart Aquaponics System for Urban Farming', *Energy Procedia*.143, pp. 342-347.

Lavanya, R. and Jutta, B., (2017) 'The Legality of Downgrading Nationally Determined Contributions under the Paris Agreement: Lessons from the US Disengagement',
Journal of Environmental Law, 29(3), pp. 537-551.

Liverpool City Council, 'Agenda item: Declaring a Climate Change Emergency by Mayor Joe Anderson, OBE, Councillor Richard Kemp CBE, Councillor Tom Crone and Councillor Steve Radford', available at:
<http://councillors.liverpool.gov.uk/mgAi.aspx?ID=137679> (accessed on 23 April 2020)

Mayor of Liverpool (2018), 'Inclusive Growth Plan', available at:
<https://liverpool.gov.uk/media/1356877/mayoral-growth-may-2018-a3-spreads.pdf>,
(accessed on 23 April 2020).

McPherson, A., (2012) 'Let Them Eat Carbon: The End of the Kyoto Protocol',
Georgia Journal of International and Comparative Law, 41(1), pp. 219-250.

Navarro, D., Kodama, G., dos Santos, M., Nogueira de Souza, A., Crispim Hundley, G., (2020) 'Analysis of the financial viability of the aquaponics (fish farming and hydroponics) system using the Monte Carlo method', *Revista Brasileira de Agropecuária Sustentável*, 9(4), pp. 20-26.

O'Brien, K., (2018) 'Cities - Good for the environment?' *International Journal of Environmental Studies*, 75(1), pp. 16–28.

Pasten, C. and Santamarina, J., (2012) 'Energy and Quality of Life' In Special Section: *Fuel Poverty Comes of Age: Commemorating 21 Years of Research and Policy*, *Energy Policy*. 49 pp. 468-476.

Razon, L., (2014) 'Life cycle analysis of an alternative to the haber-bosch process: Non-renewable energy usage and global warming potential of liquid ammonia from cyanobacteria' *Environmental Progress & Sustainable Energy*, 33(2), pp. 618-624.

Roberts, S., (2008) 'Energy, Equity and the Future of the Fuel Poor' *Foresight, Sustainable Energy Management and the Built Environment Project, Energy Policy*. 36(12): pp. 4471-4474.

Stavins, R., J. Zou, T. Brewer, M. Conte Grand, M. den Elzen, M. Finus, J. Gupta, N. Höhne, M.-K. Lee, A. Michaelowa, M. Paterson, K. Ramakrishna, G. Wen, J. Wiener, and H. Winkler, (2014) 'International Cooperation: Agreements and Instruments'. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge: Cambridge University Press, pp. 1001 - 1082.

Tomlinson, L. (2015), 'Indoor aquaponics in abandoned buildings: a potential solution to food deserts' *Sustainable Development Law & Policy*, 16(1), pp. 16-40.

UK Government (2020), 'Climate Change Act 2008', available at: <http://www.legislation.gov.uk/ukpga/2008/27/part/1/crossheading/the-target-for-2050>, (accessed on 5 July 2020).

United Nations Treaty Collection, (2020), available at: https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27, (accessed 5 July 2020)

Weindl, I., Popp, B., Bodirsky, L., Rolinski, S., Lotze-Campen, H., Biewald, A., Humpenöder, F., Dietrich, J. and Stevanović, M., (2017), 'Livestock and human use of land: Productivity trends and dietary choices as drivers of future land and carbon dynamics', *Global and Planetary Change*, 159, pp. 1-10.

Westwella, E. and Bunting, J. (2020). 'The regenerative culture of Extinction Rebellion: self-care, people care, planet care' *Environmental Politics* 29(3), pp. 546 - 551.

Wrigley, E., 'Energy and the English Industrial Revolution' Wrigley EA. *Philosophical Transactions of the Royal Society A*, available at: <https://royalsocietypublishing.org/doi/10.1098/rsta.2011.0568>, (accessed 3 July 2020)

Yedla, S. and Garg, S., (2014) 'Two Decades of International Climate Negotiations - Carbon Budget Allocation Approach to Re-shaping Developing Country Strategies', *Journal of East Asian Economic Integration*, 18(3), pp. 277-299.

Zhong, W., and Haigh, J., (2013) 'The greenhouse effect and carbon dioxide', *The Royal Meteorological Society: Weather*, 68:4, pp. 100 - 105.

3. Literature Review - The UK landscape for education

3.1 Introduction

Purpose of the literature review

The first chapter of this literature review sought to gain clarity on some of the most pressing problems facing the planet, and how the UK government and public are responding to them. The chapter concluded with the actions that need to be taken on many different issues simultaneously to address the climate crisis.

This chapter will consider the literature related to the research questions for this project to better understand how students are currently educated about environmental issues, and where gaps exist in successfully equipping students to build a low carbon future and respond to the climate crisis. The following integral themes will be explored:

1. To what extent do educational stakeholders prioritise environmental education in Merseyside schools?
2. What pedagogical methods have been used successfully to equip students to build a low carbon future?
3. What are the barriers to providing environmental education in Merseyside schools?
4. How is EdTech currently used to provide solutions for educational aims?
5. How can Farm Urban's Future Food Challenge and the EcoVerse platform be effectively developed to equip Merseyside's students to solve future food problems?

Through evaluation of the literature relating to these themes, the educational landscape relating to the development of Farm Urban's Future Food Challenge will be framed. This will allow product development to be informed by the theory and practice of existing pedagogical approaches and UK statutory strategy and policy, in addition to the identification of the gaps and pitfalls of current initiatives, which this product may serve to remedy.

Search strategy

To conduct this literature review, the library database at the University of Liverpool was utilised.

The following search terms were used: environmental education; blended learning; enterprise education; UK education; action research education; KS3 and KS4 education, pedagogical approaches; pedagogy and secondary education; EdTech; Educational Technology; skills learning; skills education; climate change and education; sustainability in education.

When reviewing the literature returned in the database enquiry, attention was paid to research that was referenced by multiple books and articles, as such work could be considered to be of direct relevance to the field of education.

For policy literature, UK government websites were explored for relevant documents including the UK education curriculum, Ofsted Reports, EdTech Strategy and Industrial strategy. Non-governmental organisations that have demonstrated a role in influencing UK educational policy were also reviewed, such as Nesta and education unions.

Study Inclusion and Exclusion Criteria

All studies utilised from this literature search were accessed through peer-reviewed journals, using the University of Liverpool library database.

Literature was categorised into policy, research, practice and theory. As this thesis focuses on secondary education in the UK, studies that focussed on primary level or higher education were excluded. Exceptions were made, however, where there were studies that were of direct relevance to the pedagogical impact of EdTech use, or methodologically similar approaches were taken to product development.

Literature that preceded the previous decade from the date of this research was excluded, to ensure the validity of research in terms of current educational practice. Again, exemptions were made for research demonstrating multiple areas of relevance, or for research that had played an important role in shaping discourse and practice in this field.

Definitions

Environmental Education: For use of this term throughout this thesis, the North American Association for Environmental Education's definition was adopted.

Environmental education (EE) provides the methods and content that can lead to environmental literacy and a more sustainable future. Through EE, people develop questioning, analysis and interpretation skills; knowledge of environmental processes and systems; skills for understanding and addressing environmental issues; and personal and civic responsibility (Franzen, 2018).

The use of the term 'Environmental Education' will predominantly address its delivery in a school context.

Education for Sustainable Development: This term is more useful when discussing students as citizens outside of the sphere of formal education. UNESCO defines education for sustainable development as

a dynamic concept that utilizes all aspects of public awareness, education and training to create or enhance an understanding of the linkages among the issues of sustainable development and to develop the knowledge, skills, perspectives, and values which will empower people of all ages to assume responsibility for creating and enjoying a sustainable future (Gough, 2005)

This term is useful specifically when describing the value-based rationale behind adopting pro-environmental behaviour change.

3.1 Environmental education

How we imagine, deliver and assess education in the UK is a deeply political phenomenon, including many different stakeholders and attracting great attention from the UK populace. As each government is elected, they will additionally bring into power their educational theories, which will shape the policies espoused during their term. For the further development of Farm Urban's Future Food Challenge, and how it can be successfully hosted on the EcoVerse platform, it is important to consider the educational landscape and context within which the programme must be developed to understand how it may be successful. What is considered to be 'successful' will be explored in the evaluation of this research.

State Actors

An obvious actor in shaping the education of young people in the UK is the government, and more specifically the Department for Education (DfE). The DfE directs what young people will learn through the production of a national curriculum for learning, and is financially accountable for education through the Education and Skills Funding Agency. Where local authorities and school districts previously had a larger role in shaping education, over the past twenty years their influence has been reduced in favour of a more direct relationship between the DfE and individual schools (Hill et al, 2016; Harris, 2012, p. 511). This has resulted in much of the tone for the delivery of secondary level education in the UK being set at a state level.

The national curriculum was first introduced in 1991 (Haydn and Harris, 2012). Schools are free to implement their own assessment systems, with guidance from the government to ensure student progress against the curriculum, until national qualifications are undertaken, usually aged 16 (Department for Education, 2013). For students with special educational needs, there is a separate curriculum and P-Scales are the accepted performance attainment targets, should students be unable to complete other national curriculum tests (Department for Education, 2014).

In 2006, the Department for Children, Schools and Families published the National Framework for Sustainable Schools, outlining a plan for making all schools sustainable (Huckle, 2009). The education inspectorate, the Office for Standards in Education, Children's Services and Skills (Ofsted), reiterated the need for such a framework, noting in their 2008 report:

In many of the schools, sustainable development was a peripheral issue, often confined to extra-curricular activities and involving only a minority of pupils. A small number of the schools placed considerable emphasis on sustainable development. In these cases, teaching was good, lessons were stimulating and pupils took an active part in improving the sustainability of the school and the wider community (Ofsted, 2008).

Despite the small progress towards establishing sustainable schools, in 2009 with the election of David Cameron and a change of government, the National Framework for Sustainability was removed (Hicks, 2020). Comparatively, in Ofsted's Education Inspection Framework introduced in 2019, there is no mention of monitoring the sustainability of schools (Ofsted, 2019).

The Department for Education's single departmental plan outlines the priorities for the UK education system (Department for Education, 2019). These can be categorised into the following themes: International standing, student welfare, professional development for teachers, and allocation of resources. Interestingly, there is no mention of the school environment - notably in the context of wellbeing, sustainability or climate change - despite the urgency of these issues as outlined in the previous chapter.

Searching specifically for the DfE's views in relation to the environment and sustainability, the DfE has provided a guidance document entitled 'top tips for sustainability in schools'. The guidance document states: 'this publication suggests practical ways for schools to become more sustainable, *should they choose to* (emphasis added), whilst at the same time saving money' (Department for Education, 2012).

The report further outlines that:

Our approach is based on the belief that schools perform better when they take responsibility for their own improvement. We want schools to make their own judgements on how sustainable development should be reflected in their ethos, day-to-day operations and through education for sustainable development (Department for Education, 2012).

Key documentation for the DfE does not discuss the environmentally sustainable development of schools as a priority. Whilst environmental issues are covered throughout the curriculum (see appendix 1), the responsibility of schools to initiate sustainable practice, such as using ethical food suppliers, reducing the carbon footprint of their institution and promoting biodiversity, is up to individual schools to decide for themselves.

As discussed in the previous chapter, Liverpool City Council has outlined a limited response to addressing climate change, despite a climate emergency being declared in 2019. There is a tension between the government's statement above, wishing individual schools to be responsible for becoming more sustainable, and a lack of response to support schools at a local level. The only mention of working cooperatively with schools to embed sustainability into school life is stated in Liverpool City Council's Inclusive Growth Plan, which identifies an aim to work 'with schools to increase understanding and engagement in protecting the environment' (Liverpool City Council, 2018). There are, however, no further details on how this is to be achieved.

Teachers' Unions

Whilst the government sets the parameters for education, there are many representative bodies for educators, each lobbying for the issues that they feel are relevant for on the ground delivery of education. The National Association for Head Teachers (NAHT) identifies in its campaigning policies that it seeks to 'Provide guidance, materials and information to support schools in educating pupils about environmental issues' (NAHT, 2020). Efforts in pursuit of this aim as highlighted on

NAHT's website have included the promotion of initiatives run by 'Eco Schools' and 'Global Action Plan', organisations resourcing students and teachers to enhance education and action concerning environmental sustainability (NAHT, 2019; NAHT 2020). This could be considered to demonstrate that whilst the DfE has outlined that the responsibility for sustainable development in schools lies with the school itself, it is third sector initiatives that can often be seen to be providing frameworks and content for schools.

In February 2020, the National Education Union (NEU), which is the largest union for teachers in the UK (NEU, 2020), joined with other unions and organisations to call for a 'EU-UK trade deal based on rights, justice and sustainability. The announcement from the NEU stated that the deal should be 'consistent with our responsibility to fight the climate emergency' (NEU, 2020). The NEU has also supported initiatives such as Climate Learning Week in February 2020, which explored the integration of activities and information about climate action for a week, as the beginning of an effort to embed themes surrounding climate action into school life.

The 2020 NEU Conference resulted in motion 56 which resolves to: support UK student climate strikers; call for a review into how UK education is preparing students for the climate emergency; for the ecological crisis to be included in Teachers' Standard (required quality of practice for teachers); An English Climate Emergency Education Act; funding for youth voices and movements; and the transition of educational buildings to net-zero carbon (NEU, 2020).

Student Action

On 15th February 2019, the first national youth climate strike was held in the UK. Much action has been taken by the UK Student Climate Network (UKSCN), which has coordinated local initiatives (UK Student Climate Network, 2020). UKSCN's list of demands calls for a green new deal; reform of the education system to prioritise a focus on the climate crisis; awareness raising for the general public; to lower the voting age; and reform the voting system to better represent the voices of young people (UKSCN, 2020). UKSCN runs a joint campaign with Students Organising for Sustainability (SOS-UK), 'Teach the Future', which focuses specifically on demands for education reform. Whilst largely articulating the need for the education system to equip teachers to develop the knowledge and skills required to build a sustainable future, the initiative also challenges the government to allow the transformation of school buildings to be net zero carbon, stating that:

The buildings and estates that we are educated in and on are often environmentally inefficient, wasteful and fully reliant on fossil fuels. These assets are our subliminal curriculum and form part of our learning on sustainability (Teach the Future, 2020).

The student movement has gained significant media attention since 2019, when 10,000 children went on strike in February of the same year (Vaughan, 2019). By March 2019, the strikes had attracted an estimated 1.4 million protesters globally (Boulianne et al, 2020). The success of the protests can in part be attributed to students' capabilities in using social media, computer literacy and Internet navigation to mobilise (Boulianne et al, 2020). It also demonstrates that many students are

increasingly aware of the climate crisis and committed to taking personal action to raise awareness and change their behaviour. In 2019, the UK Youth Parliament voted for 'Protecting the Climate' to be the 2020 UK wide campaign. Former Youth MP for Liverpool Eva Carroll stated 'overwhelmingly this year, the top issue was to protect the environment' (BBC, 2019).

The Green Schools Project Survey found that 85% of student participants said that they believed schools and colleges should be encouraging and helping students to do more to help the environment whilst 68% stated that they were interested in learning more about the environment (Students Organising for Sustainability UK, 2020). In a survey of teachers, 89% of participants agree that "UK students should always be taught about climate change, its implications for environments and societies around the world and how these implications can be addressed" (SOSUK, 2020).

Evidently, the will of both students and teachers exists to promote environmental education in schools, however both feel that teachers are not sufficiently equipped to incorporate environmental learning fully into their subject areas.

3.3 Pedagogical methods for environmental education

The climate strikes and accompanying student-led environmental organisations indicate a dual awakening in students - not only that the existing structures for their education do not necessarily represent the requirements from their future careers, but that the lives that they are being educated for are threatened by the climate crisis (SOSUK, 2020). Students will subsequently find themselves unable to be blissfully ignorant of the environmental crisis, which has been the privilege of previous generations.

How then can students continue to be engaged in an education system that can seem out-dated compared to the information that they can source through their own devices in the context of an uncertain future due to both environmental and technological changes? It is evident that there is a significant gap in providing environmental education for students, and in the development and practical application of soft skills related to solving future environmental problems. Yet, only a few educational studies have reported clear empirical results on what instructional approaches and climate education technologies best accomplish this goal (Bush, 2019).

Teaching the curriculum

One of the primary tasks of teachers is to meet the requirements of the UK curriculum to prepare students for their national examinations. School curriculums are developed in different ways by each school, however there is usually collaboration between departmental staff and senior management. During learning programme planning, the writer, for example a departmental teacher, will use the national curriculum to understand the knowledge goals for the purposes of students passing their exams, as well as regarding other areas of student welfare. They will then identify relevant topics and plan classroom activities to aid the transfer of knowledge to students, thus the school curriculum covers both content and pedagogy (General Teaching Council for England, 2011). This process will begin from the start of secondary school education, with the topics covered from years 7-9 (KS3) providing building blocks for

the learning required for passing exams, which is made more explicit during years 10 and 11. However, due to the pressures of national examinations, 63% of schools begin to explicitly teach the GCSE curriculum at KS3 (TES, 2019).

The topics relating to environmental education taught through the curriculum are outlined in appendix 1. Topics throughout the curriculum explore different aspects of the climate emergency - from population growth in geography, to human impact on the environment in science. Different subjects have the potential to be used to explore environmental issues. For example, the curriculum for food technology includes the source and seasonality for a range of foods, and it therefore would be feasible to discuss the unsustainability of agriculture in this context, or music could utilise the environment as a theme for artistic expression (National Association for Environmental Education, 2015).

Subject content often depends on how each teacher wishes to teach their subject and which topics they wish to specifically explore, therefore how much they personally know about environmental issues is likely to affect their choices around teaching environmental education. A YouGov poll suggested that 75% of teachers feel that they have received inadequate training to teach students about the environment (Taylor, 2019). Bandura suggests that beliefs about self-efficacy affect performance, which could suggest that whilst teachers do not feel confident to teach environmental issues in their classrooms, they will not choose environmental topics, despite their relevance to curriculum subjects (Kerr, 2020).

Additionally, school curricula must be designed according to how best to support students to pass their exams. The exam grades of students are important for several reasons: the grades obtained by students will affect whether a student is able to study at college and university and where; their high school and further education results will affect the jobs that students will be able pursue, and the timeline for their professional development; and the grades obtained by a year group of students will affect the national ranking of their school. Whilst exams hold such great importance for students and schools, pressure to obtain good results will be a major driver of school curriculum design.

Third party resources

There have been many external initiatives that have sought to bring environmental education into schools. Opportunities such as 'Earth Day' have provided focal points for schools to highlight environmental education during the school year (TES, 2020). Content for activities is accessible from many third sector organisations, which provide videos, infographics, and games exploring an array of environmental issues. A particularly successful initiative in UK schools and internationally has been the 'Eco Schools' programme. Eco Schools provide a framework and resources for children to implement an eco code, an eco committee and an action plan to work towards obtaining a 'Green Flag Award', highlighting a school as making substantial efforts to protect the environment (Eco-Schools, 2020).

The Eco Schools initiative brings environmental activism closer to home, by empowering students to hold themselves, their peers, teachers and school management accountable for actions relating to the environment and sustainability.

Some of the action points identified by Eco Schools include the monitoring of energy in the school, such as the use of light switches, and measures to promote biodiversity within the school grounds. Whilst this is a positive, practical measure for students to take, which can promote a sense of achievement and not least develop organisational, teamwork and leadership skills, other students may feel overwhelmed by the scale of the global issues, and feel that such activities cannot address the large scale international change required to mitigate climate change.

Evidently, if many teachers feel ill equipped to teach environmental education, they feel that their own understanding of environmental issues is wanting. As many UK teachers have been educated through the UK education system, the absence of environmental education is apparent. It must be considered that if such an obvious lack of foundation for environmental education exists and continues into adulthood, it is unlikely that third party resources alone can precipitate a change without a commitment from schools to embed environmental issues into school curriculums.

Practicing scientific research

Understanding key information relating to climate change is of course important, as this is required to conceptualise the problem and formulate a plan of scientific inquiry. The curriculum additionally emphasises the importance of developing scientific skills for inquiry, and many researchers and scientists have considered the importance of encouraging students to participate in real time scientific research to develop such skills. Bush et al raise concerns that misunderstandings concerning the science around climate change persist ‘with incorrect mental models persisting even among graduate students trained in science, technology, engineering, and math’ (Bush et al, 2018). Therefore there are evidently problems in the way that knowledge about climate change is currently transferred.

Developing classroom research by partnering with scientists on anthropogenic climate change may address the incorrect forming of frameworks for understanding the issues. Magaji et al assert that ‘it is evident that when students take ownership of their learning, leading through inquiry and the sharing of knowledge with their peers, their performance in subjects such as science can improve’ (Magaji et al, 2018). Additionally, school-industrial collaborations can allow students to see and use advanced and expensive equipment that they would otherwise have no access to (Rusten et al, 2017). This is important, as data analysis from a project where students were exposed to actual climate research resulted in increased scores on pre/post project exams, as well as a deeper understanding of the scientific concepts explored (Bush et al, 2018).

This collaborative working approach was taken by Lotto, who mentored young students to take part in research concerning vision in bumblebees, resulting in the youngest researchers to publish their findings in a peer reviewed journal (Howarth and Scott, 2014). Another example includes the Acadia Learning Project, which worked with thousands of students. The project has resulted in a comprehensive database through which it has been possible to test models for landscape scale patterns in the variability of mercury and develop new ways of using macroinvertebrates and biosentinals (Zoellick et al, 2012).

Such collaboration is important for many reasons. Many teachers struggle to motivate students without being able to highlight the relevance of the subject to students' lives. For example, national studies have demonstrated that whilst 10-14 year olds in UK education enjoyed science, most students didn't consider pursuing careers in science (Banerjee, 2017). Partnerships with academics and industry provide context to scientific learning; role models working in science from similar backgrounds for students; and inspiration and fulfilment for students whose work has contributed to real world scientific advancement (Tapia, 2019).

Many young people replicate what is visible to those around them, and feel excluded believing that scientists are 'unusually smart, white males who solve problems without much effort or help from others' (Lin-Siegler et al, 2016). However, partnerships between schools and industry widen the scope of opportunities witnessed by students. In 2020, the UK government has introduced 'T-Levels', as an alternative to A Levels. T-Levels comprise of a mixture of classroom learning and industry placement, however this opportunity is only for those taking T-Levels, rather than A Levels, and not available for students below 16 years (Department for Education, 2019).

Whilst there is much research to suggest the benefits of school-industrial partnerships, there is little research to suggest why more partnerships do not exist. Research concerning university-industrial partnerships indicates that partnerships can break down because of cultural differences between academia and industry, and largely due to a lack of communication and the establishment of shared goals before projects begin (Science Business Innovation Board, 2012). Whilst such literature is not readily available for the school context, it can be inferred that barriers to collaboration can include geographic limitations between schools and scientific learning sites, the pressures of the curriculum preventing the release of students for engagement in such activities and a lack of opportunity provided by industry. As highlighted earlier, Bush et al assert that current teaching of climate science has not resulted in successfully improving public understanding of the salient issues (Bush et al, 2018).

Subliminal learning

The aforementioned 'Teach the Future' demands highlighted the importance of subliminal learning in students' education (Teach the Future, 2020). This is the idea that students are not only being educated through the content of their lessons but also by what they witness in the spaces around them. Environmental education is made obvious by what schools are choosing to do with their space. For example, a school raising money to install their first wind turbine 'provided a working example of renewable energy which was metered by the children to better appreciate the concept of free energy' (Birney et al, 2011).

This also may include the attitude and beliefs of teachers that are made evident in their practice, a school's decision making in terms of how money is spent, and which subjects or extra curricular activities are prioritised (Merritt et al, 2019; Birney et al, 2011). For environmental education to be taught subliminally therefore, a wider ethos to promote sustainability in schools must be adopted. This may be through energy saving features in the building itself such as automatic lights or the use of recycled water for toilet flushing; the prevalence of cycling and walking to approach the school

and incentives to promote this; the use of sustainably sourced food in canteens and effective recycling.

In addition to content in lessons and the promotion of sustainable practice in school life, there is research to demonstrate the positive impact of greener spaces on mental wellbeing (Van Dijk-Wesselius, 2018). Through efforts to increase environmental sustainability through school spaces, such as the introduction of green spaces for enhancing biodiversity, evidence suggests that students may also experience psychological benefits. For example, Spring et al also consider that ‘Bringing students into relation with new foods and ideas can “widen the scope of emotional possibilities” (2013: 84) and (re) shape material sensitivities, identities and relationships available to them’ (Spring et al, 2019). Increasingly, some schools are playing a role in providing breakfasts for students, meaning that schools can play an even more significant role in shaping students’ food decisions (Spring et al, 2019).

Enhancing student access to hands-on activity and experience can develop their ability to engage with complex topics, for example, after a school visit to a farm, and engagement with the plants and animals, researchers noted that ‘the students were able to engage in interdisciplinary thinking by perceiving the relations of concepts across environmental science disciplines’ (Tan and So, 2019). Through schools committing to incorporating sustainability into all aspects of school life, including lesson content, canteen food choices, and increased green spaces, students’ environmental education may be reinforced through their subliminal learning.

3.4 Developing skills in schools

Students now require education for a world that undertakes seismic changes in shorter timescales than we have seen at any point in history. Where much of the current education system is built around the transfer of knowledge, the information that would previously have taken months or years to learn is now available within minutes from the palm of each student’s hand through technology. Good working memory is related to better GCSE results (Grimley and Banner, 2008), however, should this remain the most important basis for assessment considering the established access to information for this generation?

With such a wealth of information being so readily available, and shifts in communication technology enabling contact to be instant, how might future generations manage the high demand on their time and energy and psychological pressures to be available at all times? It is evident from literature around education in the UK that changes in pedagogy are required to meet the needs of students with reference to the technologies that will shape their careers and lives (European Commission, 2015).

It is important that students develop both hard and soft skills to meet the requirements of life within an increasingly automated age. This can include the skills needed over the next decade to work with technology, such as management of teams, and understanding and resolving conflict in the workplace (Owen, 2017). Hard skills encompass the skills, and perhaps expertise, which are required to complete a certain technical task (Ayuningtyas et al, 2015). Whilst today’s standard of literacy and numeracy, for example, are unlikely to cease to be of importance, computer literacy

has additionally become a staple requirement of any job, and indeed necessary to navigate civil systems such as bill payment and voting registration. Due to the rapid technological change which will continue to hasten exponentially, it is not possible to predict exactly what jobs will exist, industrial sectors will dominate and therefore what hard skills will be required over the next twenty years.

It is therefore increasingly important to equip students to learn new skills efficiently and support them to develop soft skills to be able to solve complex problems (Jagannathan et al, 2019). Soft skills are the attributes that we need to be able to carry out tasks, particularly in an interpersonal way (Ayuningtyas et al, 2015). This includes the methods by which we communicate, how we manage our time and how we generate ideas.

The development of soft skills is also instrumental in successfully navigating life within a technologically advanced society, for many reasons. For example, whilst the acquisition of knowledge is more accessible to many additional communities than was possible a century ago, such a vast amount of knowledge requires skilled discernment to establish its factual credibility and the potential biases of the author(s) (OECD, 2013). Furthermore, interpreting information online, and understanding the technological landscape requires collective safeguarding to mitigate potential dangers from online content, and teachers must increasingly play a role in training students to navigate online content and industry 4.0 technologies safely (Eriksson et al, 2018).

Some schools, organisations and partnerships have already implemented frameworks to articulate what skills they are seeking to support students to develop. Having reviewed the websites for the schools that take part in Farm Urban's Future Food Challenge, only one school highlights the skills framework used across the school for student skill development – North Liverpool Academy. Table 2 provides examples of the skill frameworks that were discovered in the literature review which have been used by education projects.

Organisation/institution	Framework	Components
ATC21S project	KSAVE	KSAVE - Knowledge, Skills, Attitudes, Values, Ethics. Ways of thinking, ways of working, tools for working, living in the world. (Scalise et al, 2016)
Skillsbuilder Partnership	Skillsbuilder Universal Framework	Listening, speaking, problem solving, creativity, staying positive, aiming high, leadership and teamwork (Skillsbuilder Partnership, 2020)
North Liverpool Academy	GEMS	Creativity, team work, risk taking, problem solving , determination, reflection. (North Liverpool Academy, 2020)

Table 2

The founding organisations, and institutions using them, apply these frameworks to educational content in different ways. The ATC21S project was born out of difficulties for teachers in assessing digital collaboration as a 21st century skill, and was trialled using a specific online programme requiring digital collaboration by students (Scalise et al, 2016). The Skillsbuilder Universal Framework has developed a large network of schools, businesses and employers and provides many resources and activities for the development of skills. Whilst the framework was originally developed for primary, secondary and SEN schools, the framework has expanded further for use in adult learning settings (Skillsbuilder, 2020). North Liverpool Academy's GEMS framework is incorporated in classroom learning, where students are rewarded for exemplary behaviour in one of the skills' areas through the school's E-Praise system (NLA, 2020). Chapter 5 will discuss skills frameworks in further detail, as during the product development stage of this project, EcoVerse and I chose to use the Skillsbuilder Framework for the further development of the EdTech tool.

Common to all of the frameworks is the ability to articulate the skills that are being developed by both teachers, and students. Whilst students may be able to list skills such as teamwork and creativity, without feedback from their teachers there are limited opportunities for students to learn how they have exhibited these skills in a more nuanced way. This is of relevance to students' future activities, as though some employers view a skills gap in candidates they are seeking to recruit, it has been suggested that many graduates do in fact have the skills sought, but are not aware and therefore cannot articulate them to employers (Thomasson Goodwin et al, 2019).

Similarly, without a deeper exploration of what soft skills are, activities themselves could be perceived as the only outcome, rather than the development of skills as an outcome in itself. This reduces the capacity for students to understand the transferability of skills. Cross-disciplinary collaboration is highly relevant to the success of solving global issues (Kotiranta et al, 2020). Using aquaponic farming as an example, as discussed earlier, this field of study requires a multidisciplinary approach. If students, and indeed industries and centres of learning, are unable to break down the silos within which their discipline and field of expertise operates, problem solving global issues will continue to be plagued by gaps in skills required, as those with relevant skill sets will continue to be bound by the traditional arenas in which their skills have been utilised.

3.5 Barriers to providing environmental education

Socio-economic factors affecting pedagogy

Students' education cannot be viewed in isolation from their socioeconomic situations. Students cannot leave the social and/or economic factors affecting them at the door of the classroom, any more than schools can ignore the needs and issues prevalent within the communities that they are based. It has been mentioned that the Youth Parliament in the UK voted for environmental issues to be their first campaigning issue to address during 2020. However, in 2019, the topic chosen was knife crime (British Youth Council, 2019; Price and Wright, 2019). It is natural that students may experience malaise in the face of the overwhelming challenges facing the planet, and simultaneously, for any child who is concerned about the rising knife

crime on their street, some may be disillusioned by attempts to monitor the number of times light switches are used in their classrooms due to the needs that are more evident in their daily reality.

The socioeconomic situation of schools will naturally affect their ability to exhibit pro-environmental behaviours. Many schools, and indeed teachers themselves are using their own resources to provide for students, for example funding food, school trips and uniforms (NEU and CPAG, 2018). Where child poverty is an issue within schools and amidst funding cuts to schools (Institute for Fiscal Studies, 2019), ensuring the sustainability of school practice will not be the primary issue, despite the urgency of the climate crisis. Visible needs have traditionally been met over existential needs within the current social structures through which we organise our societies.

Biases within society and our education systems create additional barriers for students for proactively or latently engaging with environmental education. For example, gendered barriers result in women traditionally being excluded from STEM subjects. This can result from such phenomena as women or men feeling that women are incapable or don't have the intellect to complete scientific study as societal tropes have subconsciously informed them that this is the case (Miller, 2017). Similarly, a lack of cohesive and inclusive communities can in some circumstances lead to fewer participants in environmental behaviours and activities from ethnic minority groups (Clarke and Agyemen, 2011).

Environmental education has often been limited to privileged groups, for example, all white spaces, due to social, economic and racial structures. Unless efforts to incorporate environmental education into mainstream education are inclusive, and understand environmentalism within the context of social injustice, understandably, appeals for behaviour change and activism will continue to exclude some communities.

Motivation and pedagogy

While the UK curriculum directs educators on the concepts to be explored in their classrooms, it is up to schools and teachers to choose how they wish to explore concepts with their students. To what extent are teachers motivated to choose themes relating to the environment? As evidenced above, there are numerous and increasing demands on teachers. Teachers, and school management, are required to equip students with the information that they are required to know in order to pass their national exams. They have responsibility for safeguarding their students, maintaining a relationship between families and the school and addressing immediate threats to safety such as domestic abuse or sexual exploitation (Department for Education, 2015).

In the midst of the demands above, which are often immediate and evident, the existential threat of the climate crisis is becoming a priority internationally, nationally and locally. Greta Thunberg, as one of the leaders of the global youth climate strikes stated 'why should I be studying for a future that soon will be no more?' (Hook, 2019). It is necessary for students to understand the future threats to the climate in order to enact change now, however it is also necessary for educators to avoid engendering hopelessness in their students (Jickling and Sterling, 2017). Simms

suggests that a shift is required to focus on the development of a deep understanding of scientific concepts and activity in students, and suggests that ‘Critical science agency has recently been explored as a means to generate the environmental action necessary to address global sustainability issues such as climate change’ (Simms, 2020).

There is an increasing understanding that schools have a significant role to play in promoting the good mental health of their students (Department for Education, 2018). To appreciate the significant existential concepts that students will be encountering early in their scientific education, Teach the Future also lists as a demand that teacher training in environmental education should include the understanding and management of ‘eco-anxiety’ (Teach the Future, 2020). Naturally, some teachers will be experiencing feelings of anxiety about the future, and it is therefore important that schools develop an approach to promote mental health resilience for both staff and students. In the midst of the wide ranging demands placed on teachers, it would be counterproductive to call for greater environmental education in schools without simultaneously addressing the workload and pressures that already exist in schools for departmental staff.

Interestingly, despite the worldwide student activism and research demonstrating that many students consider climate change to be the biggest issue of importance, it does not appear that students are adapting to live in a significantly more sustainable way, which could result from pessimism about the future (Ojala, 2018-9). For environmental education to become a fundamental pillar of education, reflection is required concerning what the fundamental aims are for our current education system (Sterling, 2017), and how we can best support schools, teachers and communities to instil the knowledge, skills and attitudes required to solve future global environmental issues.

3.6 Current uses of EdTech

Introduction

Educational Technology (EdTech) is any use of technology to enhance and deliver educational aims. This ranges from the administration of school life, for example, the use of technology to organise timetables or to communicate with parents, to in classroom apps and computer programmes to allow students to interact with the learning aims within the classroom using devices (Department for Education, 2019).

Why EdTech?

As we approach the end of the decade, the fourth industrial Revolution continues to demonstrate that the march of technological development streaks ahead of what we are capable sociologically of providing a framework to manage. Students currently undertaking secondary education find themselves on the precipice of a world defined by the technologies available, yet those that educate them have been raised and trained in a former world (Derbel, 2017). Students must be equipped to use technology appropriately for the time that they live in, in order to utilise new technologies to solve future problems. To be equipped for the labour market of the future, students must have a high level of computer literacy (Jagannathan, 2019), and

using real world technology in the classroom can help students to learn new ways of working alongside industry.

Using EdTech could have the potential to make student access to resources more equal (Jacob et al, 2016). Many schools have continued to use textbooks for decades, saving money by not keeping up to date with the latest publications, or asking parents to buy textbooks as school budgets have been reduced with a larger expectation on what they can deliver (BBC, 2017). This naturally puts schools with less financial resources at a disadvantage compared with those who are able to access the latest publications. However, the skills required to navigate digital media compared to print media are very different (Bulut and Karasakaloğlu, 2018), and without technology being utilised in the classroom, students will be disadvantaged in how they are able to process and use information effectively.

EdTech has the potential to reconfigure the spaces in which students are educated. Whilst defined spheres of learning exist, separated as 'home' and 'school', technology can provide a bridge between (Gillen and Kucirkova, 2018). Where parents are able to see more interactively how their children are progressing through the curriculum, for example, through shared platforms through which parents, students and teachers can communicate, there is potential for consistency in topics and skills for students to experience in home and school spaces (Blau and Hameiri, 2017). If parents and teachers work together, through real time communication on devices, students may be able to see better modelling of the concepts being explored, and learning can become an intergenerational experience. However, despite this potential it must also be considered that socioeconomic barriers for parents can create barriers to engagement in student learning which in turn risks creating a larger divide between pupils of different backgrounds. It has been reported in 2020 that a third of parents of children between 5-16 years of age do not have access to a laptop or computer (Boland, 2020).

Outhwaite has explored the potential benefits of EdTech in an early years setting. She has highlighted the positive impact of using technology based educational games to reach children according to their different abilities through the various ways that information can be presented. For example:

Software features including multiple representations of information, such as pictures, video, and animation, varying levels of task difficulty, clear goals and rules, learner control, task feedback and repetition, serve to create an individualised learning environment, placing the child in active control of their learning (Outhwaite, 2017).

The potential for EdTech to be used to incorporate different learning styles can be sustained throughout school and into higher education and continued professional development, if technology is used efficiently (Viorica - Torii and Carmen, 2013). The use of EdTech within the classroom could facilitate a topic being explored from a variety of different angles, according to students' needs. Additionally, as explored earlier, should more real time collaboration with industry and science be considered as a method of developing critical science agency, pedagogies supporting this approach may be bolstered by the use of technology to aid collaborative work (OECD, 2015). Many students have their devices banned from the classroom, understandably due to the numerous distractions that phones and tablets can provide.

However, by incorporating students' own knowledge of digital literacy into the classroom for the purposes of projects, specifically projects for which there is a clear and meaningful objective can increase the authenticity of the use of technology in learning (Scalese, 2016).

UK Government strategy for EdTech

In 2019, the UK government announced a new strategy for Education Technology (Department for Education, 2019). The strategy outlines the Department for Education's vision for the future uses of EdTech in schools; how the government plans to secure the digital infrastructure to achieve their vision; safety; liaison with the EdTech industry; and supporting innovation. Whilst the strategy envisages the future of how technology can dramatically change the way we educate, it recognises the lack of basic IT infrastructure in order for EdTech to effectively be used in schools. Access to the Internet varies significantly depending on where schools and pupils are geographically, with some areas unable to access high speed Internet, which is integral for the functioning of many EdTech resources (Morrison, 2018).

There is not consistent access to devices for use in classrooms, for example, one report stated that 'Only 46% of IT leaders think they have the best possible devices to support their digital learning goals' (Fujitsu, 2018). There are many login requirements for a student to be able to access a programme, such as the computer login, login to a remote server, and login required for Internet access, and tablets and laptops do not necessarily have an extensive battery life, requiring them to be plugged in. Therefore, by the time thirty students have moved to a computer lab/accessed a laptop or tablet and moved to plug it in, logged on using at least three usernames and passwords, or perhaps located the required password for the equipment being used, overcome a lack of internet connectivity and accessed the proposed programme for an activity, teachers may have indeed lost valuable time (Wilkinson and Baker, 2019).

Understanding that more needs to be done to develop IT infrastructure in schools, the EdTech strategy in part focuses on the basic administrative uses of technology that could potentially increase efficiency for a teacher's heavy workload. This could be technology for organisation including timetabling, departmental communication or assessment (Department for Education, 2019).

The EdTech strategy identifies five key areas where technology could be used to drive change:



Figure 4 (Department for Education, 2019)

Teachers are fundamental to the UK's education system, however many teachers consider their jobs to be stressful, if not extremely stressful (Mulholland, 2017). The use of technology should therefore not be an additional box to tick, but rather a means by which teachers can have more capacity to have meaningful interactions with their students, and prioritise the needs of a class over the time taken for administrative duties. The government's EdTech strategy also emphasises the aim of providing space for teachers to focus on their own professional development (DfE, 2019). Ofsted reiterated the importance of using technology to reduce teacher workload, as described by the Director of Corporate Strategy:

The Government's EdTech strategy highlights some exciting opportunities for teachers to harness technology that allows them to dedicate their energies to the substance of education: effective teaching of the curriculum that produces great outcomes for pupils (Department for Education press release, 2019).

As discussed earlier, the varied socioeconomic situations of schools result in inconsistency of the technology that can be accessed in schools financially. It is therefore of great importance that technology to ease teacher workload is developed in partnership with teachers themselves, to ensure the suitability of new technology in the context within which teachers will be using it (Fuller, 2020).

The NGO Nesta identified at their 2019 conference that, whilst there were innovations in the EdTech industry that were creative and showed promise for the future, there was a lack of dialogue between teachers and EdTech developers. Nesta released funding for the development of EdTech 'test-beds' for multi agency working to ensure that new technology successfully mapped onto the current landscape for education (Nesta, 2019). This would involve partnerships between industry and schools/educational organisations, with feedback mechanisms for an iterative process

to app development. It was also established that there must be robust outcome measurement for piloted programmes (Nesta, 2019). The call for test-beds and effective impact assessment was reiterated in the Government's EdTech strategy.

The strategy calls for effective impact assessment, with loose parameters around what impact is sought. The EdTech strategy was released shortly after a policy document for the government's industrial strategy, and there are similarities between the two documents (Department for Business, Energy and Industrial Strategy, 2017). One aspect is international competitiveness, and the need for the UK EdTech industry to be leaders in the field. As both strategies acknowledge the likelihood of increased automation of industry, there is an economic end to ensuring the digital literacy of the next generation.

The strategy has little mention of soft skills development, and no mention of the climate crisis. It could be argued that the ends of the strategies could be ultimately to bolster economic growth, though many industries, as they currently operate, are contributing to global warming through their working practices. Simms raises that 'there has been much discussion on the need to disconnect science from the economic drivers of growth and prosperity, and educate students (equally) for citizenship' (Simms, 2020). In the context of environmental education we could consider citizenship to include living responsibly to mitigate climate destruction.

How has EdTech been implemented in schools

Technology has been implemented in schools in varied ways across the UK. Many schools now have a set of computers, some portable for use in classrooms and some in an IT suite. A lot of schools now have an interactive whiteboard, which can be used for showing videos, showing slideshows, and operating Internet or app based interactive activities. Projectors are widely used in classrooms, reducing the need for teachers to write out activities or information, which can free up time during the lesson.

There are different applications to engage students actively with their learning through gamification. One example that is commonly used in schools is 'Kahoot!' which is a web based programme through which teachers can host quizzes, and students can use their devices to compete (Tutorful, 2020). Teachers can also repurpose existing programmes, for example, the use of Google Docs, for students to work together on the same documents collaboratively, or for teachers to give feedback on work. Programmes such as Microsoft Teams, commonly used within industry, are being used to organise and share work between pupils and teachers.

Searching through online recommendations and blog posts, the most popular apps used by teachers can be sorted into the following categories:

- Lesson plans - pre-made lesson plans uploaded by teachers covering a range of topics
- Gamification tools - interactive quizzes and games to learn curriculum topics
- Increasing interactivity - designs, artificial intelligence, virtual reality, augmented reality and other tools to make topics more engaging for students

- Assessment - platforms for teachers to share clear feedback on assignments to students
- Communication - platforms for students, teachers and parents to collaborate and keep updated
- Presentation - tools for creating well designed aesthetically pleasing presentations for interactive whiteboards/projectors
- Sensors and coding - platforms with accompanying kits for students to experiment with
- Ebooks - online literature and sites to effectively find high quality and age appropriate books
- Progress monitoring - tools to view trends in students' progression and highlight potential areas where a student may be struggling
- Revision - online flashcards, quizzes and games specific to revision of a topic pre-exam

The most common apps appearing on recommendations for teachers are gamification or topics and lesson plans (Tutorful, 2020; Book Widgets, 2020; Edutopia, 2020).

There has been a longer history of EdTech outside of that which is now being implemented in schools in adult education. The Open University was established in 1969, and provided distance learning for adults in Higher Education. To manage distance learning, the Open University has been at the forefront of compiling online modules and resources for students to access (Tait, 2018). This has become more common to higher education, as universities over the last two decades have increasingly used online platforms for the submission of assessments, to monitor plagiarism, to host recordings of lectures for students to revisit, and to organise timetables. There are increasing numbers of outlets for online education, such as Massive Open Online Courses, which allow anyone to enrol on a variety of online courses (MOOC, 2020).

In 2020, the UK has been significantly affected by the global COVID-19 pandemic. The pandemic has resulted in full and partial lockdowns, with citizens being asked not to leave their homes throughout the year. This has resulted in the closure of schools, and dramatic changes to how education is delivered within a short period of six months, at the time of writing. Schools are having to quickly adapt to facilitating remote learning and are quickly implementing the use of video conferencing for meetings, as well as recording lessons for pupils. Additionally many parents are becoming more involved with the delivery of their children's education than they have previously been, whilst continuing to work from home. The pandemic has highlighted the lack of digital literacy amongst many parents, in addition to a lack of access to laptops and computers at home for students (TES, 2020).

The importance of sharing a physical space and of human interaction has never been more obvious than since socialising restrictions have been implemented to reduce the spread of COVID-19. A criticism of EdTech has previously been that a movement to online learning can never replace the role and necessity of a teacher. However, whilst this sentiment rightly remains, changes outside of political and social control have created the necessity for online learning such as our society has never experienced before. Similarly, the growing awareness and action concerning the climate crisis coupled with the remarkable changes to daily life precipitated by COVID-19 has further highlighted the role that technology can play in reducing greenhouse gas

emissions through reduced travel. However, the dialogue surrounding EdTech does not highlight environmental education as a major consideration and much less a priority.

3.7 Barriers to using EdTech in schools

It is evident that there have been some very successful initiatives using EdTech, which are opening up opportunities for both students and teachers. However, as the government strategy highlights itself, and is evident from the experience of teachers and students, there are still barriers to the successful implementation of EdTech in schools. Without reflection on the rationale for introducing EdTech, it will remain to be an add-on with superficial benefits rather than an intrinsic change to education. Kelly identifies the two distinct types of barriers:

1. External barriers: e.g. IT infrastructure; time; training
2. Internal barriers: e.g. the experience of teachers in using technology; their perceptions, visions, beliefs. (Kelly, 2015; Bahçivan et al, 2018)

External barriers were already present in schools, such as the inconsistent access to high speed broadband in different schools across the UK. As discussed, the COVID-19 pandemic has highlighted the external barriers to EdTech implementation, for example socio-economic barriers to digital literacy. In the case of the pandemic, a lack of technology has prevented access to any education at all, through insufficient hardware. During 2020, some schools have had to apply for emergency funding grants to secure laptops for students through lockdown to ensure that they can still be in contact with their teachers and receive online lessons and assignments (Department for Education, 2020). The external barriers are mentioned specifically in the government's EdTech strategy as discussed, and there is an obvious link between the external barriers and internal barriers. For example, external barriers, leading to poor experience of technology in classrooms will reinforce internal barriers.

An OECD report highlighted that countries that had invested heavily in IT for education had not seen significant improvements in educational outcomes. The following rationale was considered:

One interpretation of all this is that building deep, conceptual understanding and higher-order thinking requires intensive teacher-student interactions, and technology sometimes distracts from this valuable human engagement. Another interpretation is that we have not yet become good enough at the kind of pedagogies that make the most of technology; that adding 21st-century technologies to 20th-century teaching practices will just dilute the effectiveness of teaching (OECD, 2015).

Evidently, even with improved IT infrastructure, for example, to meaningfully use EdTech in a way which may be transformative for education, means a dramatic change in pedagogy, which many teachers may, understandably, be resistant to. Currently, such changes are too far removed from the immediate concerns of the classroom, and the outcomes that teachers are trying to achieve for their students (Nesta, 2019).

To fully address the internal barriers to EdTech, training must also be accompanied by reflection about how to meaningfully use technology, to avoid EdTech from being an unnecessary ‘add on’ with little value, and resentment from those using it. Many teachers do not currently use EdTech in their classrooms which can be both because of infrastructural issues, and a lack of strategic planning for why the use of EdTech in a scenario can specifically target and bolster outcomes for learning (Kelly, 2015). Searching through blog posts and adverts for EdTech it is understandable that EdTech can in part be seen as a gimmick, or a way of making classrooms fun, which despite not being a bad end in itself, does not promote the benefits of enhanced digital literacy.

Training, therefore, must cover a wealth of issues that accompany EdTech to instil a greater understanding of the pedagogical requirements of instituting its use. For example, training to address practical issues such as how to balance the use of technology with the need for students to be away from computers, and how to manage technology as a distraction within classrooms. Training should be alongside a deeper reflection upon how the use of technology can replicate a real world experience by all parties, fostering the development of hard and soft skills.

As we continue to see such a dramatic change in technological development in such a short space of time, it is increasingly difficult to create legal and ethical structures to meet emerging challenges with new technologies and this will naturally affect how the education system adopts EdTech (Owen, 2017). An example of the type of legal and ethical issue that accompanies technological development is that of gathering and storing pupils’ data. EdTech raises the potential for using ‘personalised learning’ meaning that based on big data gathered from thousands of students, a programme can suggest or adjust learning styles to adapt to what it perceives as your learning needs. Researchers have raised the concern of ‘algorithmic bias’ and the potential for subtle discrimination to occur based on the data gathered. For example, Regan and Jesse suggest that:

Though personalized learning systems may appear to be educative and in the student’s best interest, the choice architecture of the prompts in these systems may be designed to entail more direction than suggestion (Regan and Jesse, 2019).

Regan and Jesse suggest, however, that this is easier to overcome with hybrid or blended learning programmes, through which a teacher facilitates a class which is aided by a computer programme as more control is given to the teacher in determining the learning styles implemented. (Regan and Jesse, 2019). Legislative precedent must evolve as technology develops to safeguard against the risks of increased technology use, as has already been the case. However, in the early days of EdTech use, educators must be mindful before engaging with technology, of what data companies are collecting and how it will be used before the use of any new product.

Another ethical issue is that of environmental sustainability. Although, as discussed, EdTech has the potential to disseminate scientific knowledge quickly and in real time to students, and can enable more collaborative approaches between schools and industry, the environmental footprint of technology itself must be considered. Whilst there can be benefits for the use of technology such as reduced use of paper, and

potentially reduced travel and the associated carbon footprint through online learning, technology in itself is a large contributor to anthropogenic climate change. For example, the components required for technological devices are mined at a great cost to the environment and are associated with poor labour practices. Furthermore the energy required to power digital infrastructure is immense, and the disposal of electronic devices a further threat to the environment (Selwyn, 2018).

Strategies to reduce the environmental impact of technology include; recycling devices; ensuring that machines are switched off correctly; and using renewable resources for clean energy. There is no mention of the environmental damage caused by technology in the EdTech strategy, and nor is it a topic which is evident in the discourse about EdTech. To be ethical consumers of EdTech and in particular, in trying to use EdTech to promote environmental education, the high environmental cost of technology cannot be ignored. Most students own a device, or several, and schools are building IT infrastructure, but any efforts to promote environmental education using existing digital structures must incorporate information about the carbon footprint and human cost of technology and promote good practice in the procurement, management and disposal of technological devices.

EdTech has the potential to make education more accessible geographically, economically, and for learners with different needs and learning styles. It is evident from the emerging technologies for education, and from the inescapable use of technology in modern British life that students must have a good standard of digital literacy. However, the intersectional experiences of pupils must be considered to understand how EdTech can be utilised in the best possible way for all learners. Single parties in isolation developing EdTech resources will not be able to meet the needs of schools, teachers and students. EdTech development must be a holistic and multi-disciplinary activity with extensive consultation with diverse groups in order to achieve it's full potential for education.

3.8 Summary

This chapter has explored the trajectory of environmental education within the last two decades. During this time, educational priorities have changed from an interventionist approach of implementing sustainability in schools through the National Framework for Sustainability, to the view that this decision and responsibility lies with schools. Environmental education is covered in a variety of ways throughout the curriculum. However, topics relating to the environment are not explored to their fullest extent, which is arguably due to a lack of confidence in many teachers, who feel ill equipped and under resourced to deliver environmental education. Through increased eco-activism, many students are calling for environmental education to be a priority and focal point for their education, as addressing the climate crisis is a necessity for preventing future catastrophe.

Different pedagogies have been utilised to deliver environmental education, but there is evidence to suggest that the best outcomes for increased depth and breadth of knowledge relating to global issues have been facilitated through industrial-educational partnership projects. Providing students with the opportunity to work with scientists, perhaps see role models from their community and have access to state of the art facilities can ignite passion in students, whilst contributing to real time

scientific research can increase student's self belief and understanding in concepts. Increasingly, schools and other educational organisations are implementing skill-based learning. Whilst continuing to increase students' knowledge around a topic, this approach places greater emphasis on the development of hard and soft skills.

The move towards skill-based education is part of a wider discussion around the purpose of education. Students' own understanding of the purpose of their education, as articulated through the Teach the Future demands, demonstrates a belief that education should be more than knowledge to pass exams, but an attempt to empower students to tackle future global problems by providing the relevant skills, knowledge and resources to problem solve. The transfer of environmental education is not merely in the classroom, but also through what students witness in the space around them and what is modelled to them through educators.

There are pressures on both students and schools resulting from socioeconomic inequality. Organisations such as CPAG suggest that funding cuts to schools have resulted in an increase in child poverty. This affects a school's ability to prioritise environmental education, as investment in relevant initiatives may be diverted to additional support for families, or providing basic stationery or books to pupils. It is therefore evident that environmental education cannot be separated from the socioeconomic needs of communities as whilst it must be a priority for the future, the daily needs of pupils will be met before more distant existential needs are considered.

Education Technology is an increasingly thriving industry, although it has been claimed that developments in this field have not served the needs of educators due to a lack of collaboration during product development. EdTech can include the use of any technology for educational purposes, but reference to EdTech usually relates to online resources and apps to make learning fun for students, or administration easier for teachers. Whilst technology has much potential to diversify pedagogies to incorporate a wider range of learning styles, a lack of IT infrastructure at home or school could further widen the gap between the opportunities for rich and poor students, and therefore EdTech also cannot be considered in isolation from the socioeconomic reality of students. Teachers may not wish to use technology in the classroom, as if not employed correctly; EdTech can be time consuming without yielding positive results. However, the more that technology can be incorporated smoothly into lessons in a way that is relevant to the session, the larger chance of students enhancing their digital literacy, which will undoubtedly be of great importance to their future.

Having explored the educational landscape for environmental education and technology use in schools, chapter 5 will explain the product development journey for EcoVerse, as the company seeks to host educational content for low carbon technologies.

3.9 References

- Ayuningtyas, L., Djatmika, E., Wardana, L., (2015), 'Hard and soft skills enhancement in entrepreneurship learning for the twelfth grade students of SMK Kartika, IV-1 Malang', *Journal of Education and Practice*, 6(29), pp. 188-194.
- Bahçivan, E., Güneş E., Üstündağ, M., (2018) 'A comprehensive model covering prospective teachers' technology use: the relationships among self, teaching and learning conceptions and attitudes', *Technology, Pedagogy and Education*, 27(4), pp. 399-416.
- Banerjee, P., (2017), 'Is informal education the answer to increasing and widening participation in STEM education?', *Review of Education*, 5(2), pp. 202-224.
- BBC (2017), 'Textbook spends drop 30% in Essex secondary schools', *BBC News*, 17 June 2017.
- BBC (2019), 'Meet Liverpool's UK Youth Parliament Member Eva Carroll', *BBC News*, 21 November 2019.
- Birney, A., Kellard, B., Reed, J., 'The journey of sustainable schools: developing and embedding sustainability', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/339991/the-journey-of-sustainable-schools-developing-and-embedding-sustainability.pdf, accessed on 9 August 2020.
- Blau, I and Hameiri, M., (2017), 'Ubiquitous mobile educational data management by teachers, students and parents: Does technology change school-family communication and parental involvement?', *Education and Information Technologies*, 22(3), pp. 1-17.
- Boland, H., (2020) 'The children left behind as schools go digital', *The Telegraph Online*, 6 May 2020.
- Book Widgets (2020), '10 EdTech apps teachers should use in the 2020 classroom', available at: <https://www.bookwidgets.com/blog/2020/01/10-edtech-apps-teachers-should-use-in-the-2020-classroom-bett-inspiration>, accessed 1 September 2020.
- Boulianne, S., Lalancette, M., Ilkiw, D. 'School Strike 4 Climate: Social Media and the International Youth Protest on Climate Change' *Media and Communication*, 8(2), pp. 208-218.
- British Youth Council, (2019), available at: <https://www.byc.org.uk/news/2019/uk-youth-parliament-launch-action-against-knife-crime>, accessed on 9 August 2020.
- Bulut, B., and Karasakaloğlu, N., (2018), 'Digital Reading Disposition Scale: A Study of Validity and Reliability', *Universal Journal of Educational Research* 6(4) pp. 613-618.
- Bush, D., Sieber, R., Seiler, G., Chandler, M., Chmura, G., (2019) 'Bringing climate scientist's tools into classrooms to improve conceptual understandings' *Journal of Environmental Studies and Sciences* 9(1), pp. 25 - 34.

Clarke, L., and Agyemen J., 'Is there more to environmental participation than meets the eye? Understanding agency, empowerment and disempowerment among black and minority ethnic communities' *Area*, 43(1), pp. 88-94.

Department for Education (2012) 'Top Tips for Sustainability in Schools', available at <https://www.gov.uk/government/publications/top-tips-for-sustainability-in-schools>, accessed on: 12 June 2020.

Department for Education (2013), 'The National Curriculum: Overview' (Series: National Curriculum), available at <https://www.gov.uk/national-curriculum>, accessed on 2 July 2020.

Department for Education (2014), 'P-Scales: Attainment Targets for Pupils with SEN', available at <https://www.gov.uk/government/publications/p-scales-attainment-targets-for-pupils-with-sen>, accessed on 14 June 2020.

Department for Education (2015), 'Keeping children safe in education' available at: <https://www.gov.uk/government/publications/keeping-children-safe-in-education--2>, accessed on 10 August 2020.

Department for Business, Energy and Industrial Strategy (2017), 'Industrial Strategy: building a Britain fit for the future', available at: <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>, accessed on 12 August 2020.

Department for Education (2018), 'Mental Health and Behaviour in Schools', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/755135/Mental_health_and_behaviour_in_schools_.pdf, accessed on 2 August 2020.

Department for Education (2019), 'Department for Education Single Departmental Plan', available at <https://www.gov.uk/government/publications/department-for-education-single-departmental-plan/department-for-education-single-departmental-plan--2>, accessed on: 3 June 2020.

Department for Education (2019) 'Press release: EdTech Strategy marks 'new era' for schools', available at: <https://www.gov.uk/government/news/edtech-strategy-marks-new-era-for-schools#:~:text=The%20Government's%20EdTech%20strategy%20highlights,produces%20great%20outcomes%20for%20pupils.>, accessed on 2 August 2020.

Department for Education (2019), 'Industry Placements', available at: <https://www.gov.uk/guidance/industry-placements>, accessed on 9 August 2020.

Department for Education (2019), 'Realising the potential of technology in education', available at: <https://www.gov.uk/government/publications/realising-the-potential-of-technology-in-education>, accessed on 10 August 2020.

Department for Education (2020), 'Get help with technology during coronavirus (COVID-19)', available at: <https://www.gov.uk/guidance/get-help-with-technology-for-remote-education-during-coronavirus-covid-19>, accessed 6 September 2020.

- Derbel, F. (2017). 'Technology-Capable Teachers Transitioning to Technology-Challenged Schools'. *Electronic Journal of e-Learning*. 15(269), pp. 269-280.
- Eco Schools (2020) available at: <https://www.eco-schools.org.uk/>, accessed on 9 August 2020.
- Edutopia (2020), '12 Awesome EdTech apps', available at: <https://www.edutopia.org/blog/12-awesome-edtech-apps-vicki-davis>, accessed on 1 September 2020.
- Eriksson, H., Högdin, S., Isaksson A., (2018) 'Education and Career Choices: How the School Can Support Young People to Develop Knowledge and Decision-making Skills', *Universal Journal of Educational Research* 6(9), pp. 1900 - 1908.
- European Commission, (2015), 'Science education for responsible citizenship', available at: https://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf, accessed on 9 August 2020.
- Franzen, R., (2018), 'Environmental education in teacher education programs: Incorporation and use of professional guidelines', *The Journal of Sustainability Education*, Volume 16, pp. 1-18.
- Fuller, C., (2020) 'Education Innovation Clusters: Supporting transformative teaching and learning', *Childhood Education*, 96(1), pp. 34-47.
- Fujitsu (2018), 'Research Report: UK, the road to digital learning', available at: <https://www.birmingham.ac.uk/Documents/HEFI/FUJ-Education-Report-UK.pdf>, accessed on 11 August 2020.
- GCSE Guide (2020), 'AQA GCSE science past papers', available at: <https://gcseguide.co.uk/papers/aqa/science/>, accessed on 1 September 2020.
- General Teaching Council for England, (2011), *Creating a curriculum for learning: Research for Teachers anthology 4*, available at: http://webcache.googleusercontent.com/search?q=cache:wBg2SO8VFcAJ:dera.ioe.ac.uk/10000/1/creating_a_curriculum+&cd=9&hl=en&ct=clnk&gl=uk, accessed on 8 August 2020.
- Grimley M., and Banner, G., (2008), 'Working memory, cognitive style, and behavioural predictors of GCSE exam success', *Educational Psychology*, 28(3), pp. 341-351.
- Harris, N., (2012) 'Local Authorities and the Accountability Gap in a Fragmenting Schools System' *The Modern Law Review* 75(4) pp. 511 - 546.
- Haydn, T. and Harris, R. (2012) 'What happens to a subject in a 'free market' curriculum? A study of secondary school history in the UK' *Research Papers in Education*, 27 (1) pp. 81-101.

Hicks, D., (2020) 'Teaching for a Better World' available at: <https://www.teaching4abetterworld.co.uk/sustainable.html>, accessed on 2 June 2020.

Hill, D., Lewis, C. and Yarker, P., 'Conservative Education Reloaded: Policy, Ideology and Impacts in England', *Journal for Critical Education Policy Studies*, 14(3), pp. 1-42.

Hook, L., (2019), 'Greta Thunberg "all my life I've been the invisible girl"', *The Financial Times*, 22 February 2019.

Huckle, J., (2009) 'Sustainable schools: responding to new challenges and opportunities' *Geography*, 94, (1), pp. 13-21.

Institute for Fiscal Studies, '2019 Annual Report on Education Spending in England', available at <https://www.ifs.org.uk/publications/14369>, accessed on 10 August 2020.

Jacob, B., Berger, D., Hart, C., and Loeb, S., (2016) 'Can Technology Help Promote Equality of Educational Opportunities?' *RSF: The Russell Sage Foundation Journal of the Social Sciences*, 2(5), pp. 242-271.

Jagannathan, S., Ra, S., Maclean R., (2019) 'Dominant recent trends impacting on jobs and labor markets - An Overview', *International Journal of Training Research*, 17(1), pp. 1-11.

Jickling, B. and Sterling, S. (2017) *Post-sustainability and Environmental Education: Remaking Education for the Future*, Palgrave Macmillan, DOI 10.1007/978-3-319-51322-5_1.

Jones, K., and Tymms, P., (2014), 'Ofsted's role in promoting school improvement: the mechanisms of the school inspection system in England' *Oxford review of education*, 40(3), pp. 315-330.

Kelly, D., (2015) 'Overcoming Barriers to Classroom Technology Integration' *Educational Technology*, 55(2), pp. 40-43.

Kerr, K., (2020) 'Teacher development through co teaching outdoor science and environmental education across the elementary-middle school transition', *The Journal of Environmental Education*, 51(1), pp. 29-43.

Kotiranta, A., Tahvanainen, A., Kovalainen, A., Poutanen. S., (2020) 'Forms and varieties of research and industry collaboration across disciplines', *Heliyon*, 6(3), pp. 1-18.

Lin-Siegler, X., Ahn, J., Chen, J., (2016), 'Even Einstein Struggled: Effects of Learning About Great Scientists' Struggles on High School Students' Motivation to Learn Science', *Journal of Educational Psychology* 108(3), pp. 314 –328.

- Liverpool City Council (2018), 'Inclusive Growth Plan', available at <https://liverpool.gov.uk/media/1356877/mayoral-growth-may-2018-a3-spreads.pdf>, accessed on 15 June 2020.
- Magaji, A., Ade-Ojo, G., Betteney, M. (2018) 'Towards a pedagogy of science teaching: an exploration of the impact of students-led questioning and feedback on the attainment of Key Stage 3 Science students in a UK school, *International Journal of Science Education*, 40(9), pp. 1076-1093.
- Merritt, E., Hale, A., Archambault, L., (2019) 'Changes in Pre-Service Teachers' Values, Sense of Agency, Motivation and Consumption Practices: A Case Study of an Education for Sustainability Course Eileen Merritt' *Sustainability*, 11(155), doi:10.3390/su11010155.
- Miller, B., (2017), 'Navigating STEM: Afro Caribbean Women Overcoming Barriers of Gender and Race', *Sage Open*, Volume 7, pp. 1-14.
- MOOC, (2020), 'About MOOCs' available at: <https://www.mooc.org/>, accessed on 1 September 2020.
- Morrison, C., (2018), 'More than 1 million children's education at risk due to poor broadband access, finds study', *Independent*, 27 March 2018.
- Mulholland, R., McKinlay, A., Sproule, J., (2017), 'Teachers in need of space: the content and changing context of work', *Educational Review*, 69(2), pp. 181–200.
- NAHT, (2019), 'Global Action Plan: Take part in Their New Towards Clean Air Classrooms Programme', available at <https://www.naht.org.uk/news-and-opinion/news/curriculum-and-assessment-news/global-action-plan-take-part-in-their-new-towards-clean-air-classrooms-programme/>, accessed 15 June 2020.
- NAHT, (2020), 'Curriculum and Assessment', available at <https://www.naht.org.uk/our-priorities/curriculum-and-assessment/>, accessed 15 June 2020.
- NAHT (2020), 'Join the Eco-Schools Programme and Engage Your School and Wider Community in Environmental Projects', available at <https://www.naht.org.uk/news-and-opinion/news/curriculum-and-assessment-news/join-the-eco-schools-programme-and-engage-your-school-and-wider-community-in-environmental-projects/>, accessed on 16 June 2020.
- National Association for Environmental Education, (2015), *The Environmental Curriculum*, available at https://naee.org.uk/wp-content/uploads/2015/06/NAEE_The_Environmental_Curriculum.pdf, accessed on 8 August 2020.
- Nesta (2019) 'Making the most of technology in education', available at: https://media.nesta.org.uk/documents/Making_the_Most_of_Technology_in_Education_03-07-19.pdf, accessed on 5 August 2020.

Nesta (2019), 'Schools and colleges in England: Join the EdTech Innovation Testbed!', available at: <https://www.nesta.org.uk/project/edtech-innovation-testbed/schools-colleges/>, accessed on 12 August 2020.

NEU and CPAG (2018), 'Child Poverty and education: a survey of the experiences of NEU members', available at: <https://cpag.org.uk/policy-and-campaigns/report/child-poverty-and-education-survey-experiences-neu-members#:~:text=Child%20poverty%20and%20education%3A%20A%20survey%20of%20the%20experiences%20of%20NEU%20members,-Report&text=60%25%20of%20respondents%20think%20that,think%20it%20has%20worsened%20significantly.,> accessed on 10 August 2020.

NEU (2020), 'EPI on Technical Education', available at <https://neu.org.uk/press-releases/epi-technical-education>, accessed on 6 August 2020.

NEU (2020), 'Why Join' available at <https://neu.org.uk/why-join>, accessed on 15 June 2020.

NEU (2020), 'NEU joins civil society groups in demanding social and environmental protection', available at <https://neu.org.uk/press-releases/neu-joins-civil-society-groups-demanding-social-and-environmental-protection>, accessed on June 15 2020.

NEU (2020) 'NEU Annual Conference 2020, Bournemouth, Conference Motions' available at: <https://neu.org.uk/media/8896/view>, accessed on 15 June 2020.

North Liverpool Academy, (2020), available at <https://northliverpoolacademy.co.uk/gems-2/>, accessed on 9 August 2020.

OECD (2015), *Students, Computers and Learning: Making the Connection*, (PISA, OECD Publishing). Available at: <http://dx.doi.org/10.1787/9789264239555-en>

Ofsted, (2008), 'Schools and Sustainability: A Climate for Change?', available at: <http://esd.escalate.ac.uk/downloads/1768.pdf>, accessed on 2 June 2020.

Ofsted, (2019), 'The Education Inspection Framework', available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801429/Education_inspection_framework.pdf, accessed on 2 June 2020.

Ojala, M., (2018-9), 'Eco Anxiety', *Royal Society for the Encouragement of Arts, Manufactures and Commerce*, 164(4), pp. 10-15.

Outhwaite, L., (2017) 'Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children' *Computers & Education*, Volume 108, pp. 43 – 59.

Owen, J., (2017) 'Education must transform to make people ready for AI', *Financial Times*, available at <https://www.ft.com/content/ab5daa64-d100-11e7-947e-flea5435bcc7>, accessed on 31 July 2020.

- Price, M., and Wright, L., (2019) 'Liverpool teenagers 'paid money to stab other youths', *BBC News*, 17 June 2019.
- Rusten, G., Hermelin, B., 'Cross-sector collaboration in upper secondary school vocational education: experiences from two industrial towns in Sweden and Norway', *Journal of Education and Work*, 30(8), pp. 813-826.
- Scalise, K., (2016) 'Student collaboration and school educational technology: Technology integration practices in the classroom', *Journal on School Educational Technology*, 11(4) pp. 53-63.
- Selwyn, N., (2019) 'EdTech is killing us all: facing up to the environmental consequences of digital education', available at: <https://lens.monash.edu/@education/2018/10/25/1363185/edtech-is-killing-us-all>, accessed on 5 August 2020.
- Simms, W., (2020) 'Bringing environmental identity research into the classroom context: examining the theoretical foundations influencing its current use in the literature', *Studies in Science Education*, 56(1), pp. 35-76.
- Skillsbuilder Partnership (2020) available at: <https://www.skillsbuilder.org/>, accessed on 30 July 2020.
- Spring, C., Adams, M., Hardman, M., (2019) 'Sites of learning: Exploring political ecologies and visceral pedagogies of surplus food redistribution in the UK' *Policy Futures in Education*, 17(7) pp. 844–861.
- Sterling S. (2017) *Assuming the Future: Repurposing Education in a Volatile Age*. In: Jickling B., Sterling S. (eds) *Post-Sustainability and Environmental Education*. Palgrave Studies in Education and the Environment. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-51322-5_3
- Science Business Innovation Board (2012), 'Making Industry-University Partnerships Work', available at: https://www.praxisauril.org.uk/sites/praxisunico.org.uk/files/Making-industry-university-partnerships-work_EU.pdf, accessed on 9 August 2020.
- Students Organising for Sustainability UK (2020) 'Our Research', available at: <https://sustainability.nus.org.uk/our-research/our-research-reports/schools-and-sustainability/school-sustainability-survey>, accessed on 17 June 2020.
- Students Organising for Sustainability UK (2020) 'Teachers and Climate Change Education', available at: <https://sustainability.nus.org.uk/our-research/our-research-reports/schools-and-sustainability/teachers-climate-change>, accessed on 17 June 2020.
- Tait, A., (2018) 'Open Universities: the next phase' *Asian Association of Open Universities Journal*, 13(1), pp. 13-23.
- Tan, E., and So, H., (2019) 'Role of environmental interaction in interdisciplinary thinking: from knowledge resources perspectives', *The Journal of Environmental Education*, 50(2), pp. 113-130,

Tapia, R., (2019) ‘‘The precious few’ must press for change: Underrepresented minorities in STEM need others like them as leaders and role models’ *ASEE Prism*, 29(2), pp. 52-52.

Taylor, M., (2019) ‘Teachers want climate crisis training, poll shows’, *The Guardian*, 21 June 2019.

Teach the Future, (2020) ‘Asks’, available at: <https://www.teachthefuture.uk/hub/44e33423-98c7-4882-9e7f-81c8fd450722>, accessed on 2 July 2020.

TES (2019), ‘Exclusive: 63% of schools extend GCSEs into key stage 3’, available at: <https://www.tes.com/news/exclusive-63-schools-extend-gcses-key-stage-3>, accessed on 8 August 2020.

TES (2020), ‘Celebrating Earth Day in the classroom’, available at: <https://www.tes.com/teaching-resources/blog/celebrating-earth-day-classroom>, accessed on 9 August 2020.

Thomasson Goodwin, J., Goh, J., Verkoeyen, S., Lithgow, K., ‘Can students be taught to articulate employability skills?’, *Education and Training* 61(4), pp. 445-460.

UK Student Climate Network (2020), available at: <https://ukscn.org/about-us/>, accessed on 16 June 2020.

UK Student Climate Network (2020) ‘we, the students, demand...’, available at: <https://ukscn.org/our-demands/>, accessed on 16 June 2020.

Van Dijk-Wesselius, J.E., Hovinga, D., Maas, J., van Vugt, M., van den Berg, A.E., (2018) ‘The impact of greening schoolyards on the appreciation, and physical, cognitive and social-emotional well-being of schoolchildren: A prospective intervention study’, *Landscape and Urban Planning*, 180, pp. 15-26.

Vaughan, A., (2019) ‘Climate protest goes global’. *New Scientist*, 241(3221), p. 7.

Viorica – Torii, C., Carmen, A., (2013) ‘The Impact of Educational Technology on the Learning Styles of Students’, *Procedia - Social and Behavioral Sciences*, 83, pp. 851 – 855.

Wilkinson, N and Baker, T., (2019) ‘Will technology solve teacher workload?’, *Nesta*, available at: <https://www.nesta.org.uk/blog/will-technology-solve-teacher-workload/>, accessed on 12 August 2020.

Zoellick, B., Nelson, S., and Schaufli, M., (2012) ‘Participatory science and education: bringing both views into focus’, *Frontiers in Ecology and the Environment*, 10(6), pp. 310-313.

4. Theory and Methodology

This research seeks to explore three themes and the intersection between them – environmental education, educational technology and building a low carbon future. The research question explored through this thesis is:

Can environmental education be successfully facilitated through an EdTech tool to build a low carbon future?

To build a low carbon future, many actions must be taken simultaneously, as there is no one single party or activity responsible for the dangerously high level of carbon emissions. A significant driver of fossil fuel use and carbon emissions, however, is the global food system, as discussed in chapter 2. For this reason, the research question seeks to explore how individuals can challenge conventional food production methods and demand a more sustainable industry. This could be through the awareness raised about the issues and resultant activism, a change in food consumption behaviours, or indeed innovations in farming methods to enhance sustainability.

This thesis explores the role that education technology could play in inspiring users to develop learning and skills around low carbon technologies. The first educational programme to be hosted on the EcoVerse platform will be the Future Food Challenge. Originally the research design for this thesis sought to collect data to better understand the experience of participants during the third delivery of the Future Food Challenge, using the EcoVerse platform. However, due to the COVID-19 pandemic, the Future Food Challenge had to be cancelled as schools closed. As the data could not be collected as originally planned, an alternative research methodology was determined.

4.1 Research design

Action Research

In order to fully understand the programme content to be hosted by EcoVerse, I participated as a volunteer in Farm Urban and EcoVerse's educational activities. I used an Action Research approach:

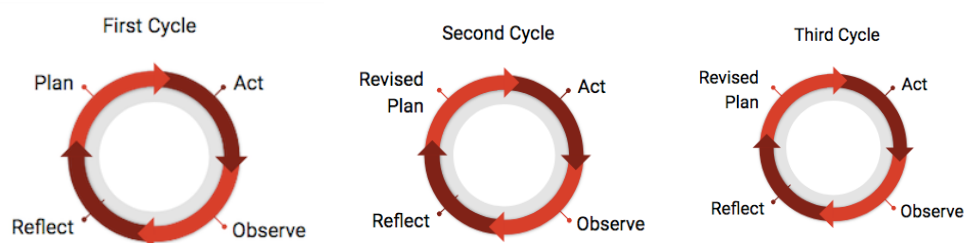


Figure 5 - adapted from Life Changes Trust Evaluation Toolkit

An interpretive paradigm was used to conduct Action Research, seeking an inductive theory to understand 'local knowledge' (Willis and Edwards, 2014). Action Research is a methodology by which cycles of research are conducted, and knowledge or theory

generated by each cycle is incorporated into the design and delivery of the next. For each cycle, data is collected, analysed and interpreted, action strategies are developed to seek positive change, and evaluation is completed before the next cycle of research begins (Somekh, 2006).

After conducting an initial literature review, for the first cycle of research, the researcher volunteered with the Farm Urban and EcoVerse teams and became acquainted with the aims, missions and values of both organisations. Rather than collecting data, the Future Food Challenge was explored by reviewing the programme content and reading the independent evaluation conducted after the Future Food Challenge first took place in 2017-18. Relevant items were added to the literature review during this time. Through the first cycle of research, a theoretical framework was developed to inform the next two research cycles.

4.2 Creating a theoretical framework

Through the literature review, theoretical content was utilised to shape the trajectory of this research. Whilst the literature demonstrated that both students and teachers would like to know more about environmental issues, there is no evident coherent theoretical framework to implement environmental education in schools.

The following deductions were made from the literature review:

Environmental education

1. To embed environmental education in schools, topics relating to the environment must feature on exams and sustainable activities must be supported with funding.
2. By abandoning policies such as the National Framework for Sustainability, governments have significantly reduced opportunities for environmental education and eco-sustainability by removing the monitoring of activities by Ofsted.
3. By ensuring the presence of green spaces and/or pro-environmental features in schools, the mental health of students can be enhanced as well as their subliminal learning about sustainability.
4. Misinformation about the environment, which exists into adulthood, will continue to pervade public understanding of the climate crisis until there is a firm basis of environmental education explored through a variety of interdisciplinary lenses.
5. Collaboration between scientists and schools has demonstrated success in enhancing educational outcomes and increasing the depth and range of knowledge about environmental issues. However, there is a gap in the literature concerning the evaluation of such initiatives in secondary education.

Skill development

6. As the use of technology results in changes to employment, students must be equipped to develop the skills that will be relevant to their future.

7. The use of a skills framework can help students to understand the skills that they are developing, the transferability of their skills. A framework can also aid students in articulating their skill sets.
8. Ensuring digital literacy must be an educational priority.

EdTech

9. Whilst scientific-educational projects can prove successful, continuing collaboration can be limited due to the practicalities of facilitating the partnership. An EdTech tool could help collaboration become sustainable and students could benefit from real time engagement with science and industry.
10. The use of EdTech in schools has the potential to facilitate education through multiple learning styles according to learner needs.
11. The development of EdTech must be a holistic endeavour, ensuring the collaboration of all stakeholders and use of intersectional data during research and development.

Inclusivity

12. Students can be excluded from engagement with environmental education due to other barriers associated with socioeconomic disparity.
13. Successful use of EdTech must accompany engagement with multiple barriers that students may face in using technology.
14. Environmental education must also engage with issues of social and economic inequality, which can prevent many groups from enacting pro-environmental behaviour.

The following theoretical framework was established to inform a data analysis. The theoretical framework is summarised below:

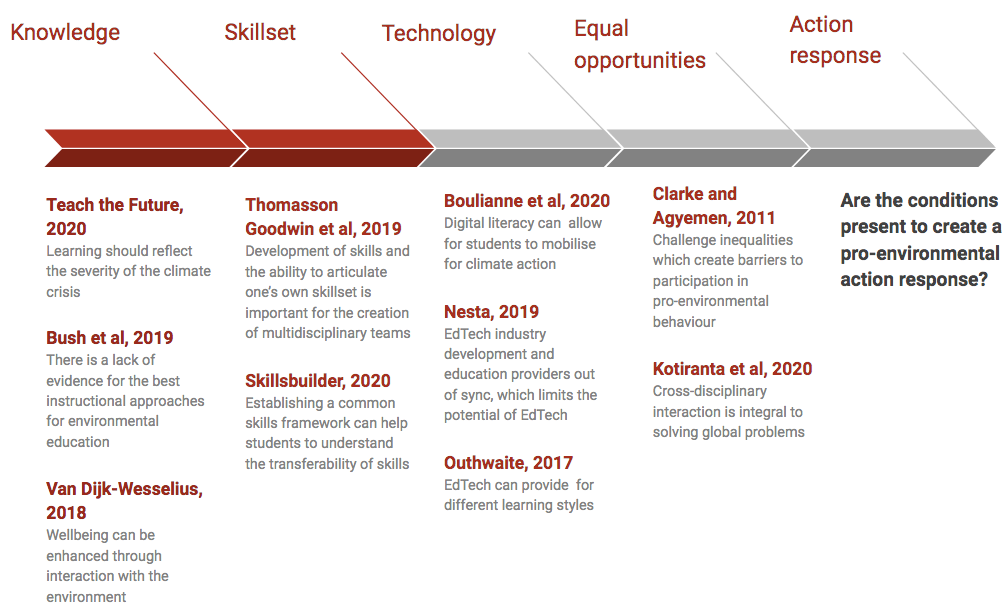


Figure 6

Drawn from the literature review and observations which emerged as research cycle one began, the theoretical framework suggests that should each stage of the theoretical framework be comprehensively considered when teaching environmental education, there is more likely to be a pro-environmental action response. The stages include delivering relevant knowledge content, employing the use of a skills framework, using appropriate technology and developing digital literacy to enhance connection with pro-environmental dialogue and organisations and challenging barriers that prevent the participation of any group in pro-environmental spaces.

The theoretical framework was tested throughout the following cycles of research. For the second cycle of research, as a volunteer, the researcher observed the delivery of the Future Food Challenge in different settings, and developed resources based upon observations to meet the conditions of the theoretical framework. Previous knowledge was implemented that had been gained from shadowing the organisations and reading the evaluation, alongside observations of delivery, to help the EcoVerse team to develop online content for the platform.

The third cycle of research concerned data collection and analysis for this thesis. Various data sets were considered that would support the development of a high quality EdTech tool for low carbon initiatives – the EcoVerse platform. These included:

- 1) TEDx talk feedback – after Farm Urban delivered the TEDx talk to schools across Merseyside, feedback forms were collected from the students present. This resulted in a dataset of 1,204 forms including the reflections of students after hearing a talk about sustainable agriculture.
- 2) Teacher interviews – semi-structured interviews with teachers from participant schools who facilitated the Future Food Challenge using the EcoVerse platform.
- 3) Student feedback throughout the programme – surveys completed by participant students at the beginning and end of the Future Food Challenge to understand their experience of using the EcoVerse platform.
- 4) Classroom observations – visiting participating schools to observe how the EcoVerse platform was being utilised in different settings.

Considering what was possible within the timeframe of the thesis, it was decided that teacher interviews would be conducted and feedback gathered from students about their experience of participating in the Future Food Challenge by using the EcoVerse platform. This data would be collected to understand the specific successes and challenges of using the EcoVerse platform for the first time. The data collected was also going to explore which of the conditions outlined in the theoretical framework had been met and the extent to which taking part in the programme using the EcoVerse platform had resulted in action responses from project participants.

It was not possible to complete data collection as planned due to schools closing as a result of the COVID-19 pandemic. Whilst this was disappointing, TEDx talk feedback had already been identified as a useful dataset for understanding how students responded to hearing messages about sustainable agriculture and what, if any, themes resonated with students in terms of inspiring them to take personal action. For the revised data collection plan, TEDx talk data gathered in Autumn 2019 was processed

in addition to conducting interviews with teachers who had facilitated the Future Food Challenge previously. The interviews focussed on both the teachers’ understanding of environmental education in Merseyside, as well as uses or barriers to the use of EdTech.

4.3 Methodology

Farm Urban’s TEDx talk feedback

To explore student responses to environmental education, data gathered by Farm Urban was utilised. Farm Urban had collected feedback forms from students immediately after hearing Farm Urban’s TEDx talk in 2019-2020 (n = 1204). Feedback forms were collected to understand how useful or interesting students found the talk, in addition to providing impact assessment to funders. Consent was established on the feedback forms to share the disclosed information, which was anonymous, with the University of Liverpool. Students across Merseyside filled in feedback forms directly after listening to Farm Urban’s TEDx talk.

The talk explores the following themes relating to environmental education, sustainable farming and the establishment of Farm Urban as a social enterprise in Liverpool:



As student response to environmental education is an underrepresented area of research, Grounded Theory was used to understand the data collected and test the provisional theoretical framework that had been developed. The rationale for using Grounded Theory arose from an initial consideration of the data. There appeared to be unanticipated responses throughout the first review of the data, and it was therefore decided that coding would be used to formulate an inducted theory (Wiesche et al, 2017).

Initial review of the data

When initially reviewing the data in a raw format, it appeared as though there was an equal mix of students who considered the talk in relation to their personal aspirations

or as a call to action for the environment. It was evident that some students were able to identify specific actions that they could take to enact pro-environmental behaviours, whilst others reflected on new information concerning sustainable agriculture and contextualised the information within their own worldview.

As expected, a number of students described an emotional response to the talk. It was interesting that some students expressed gratitude at both being informed relating to the subject content, that Farm Urban was attempting to innovate solutions to future food problems. Some students even described surprise when considering that a group of people cared about their future. From an initial review of the data, it was considered that when students thought about their personal future, and in particular the effect of climate change on their families or future families, this was more likely to elicit an emotional response. As outlined above, the TEDx talk covers five key themes, which appeared to be represented in the student responses.

Themes emerging from the data

Students had a mixed understanding of the issues affecting the environment but appeared to have previously reflected less on the role of agriculture as a driver of climate change. Students learnt about how the speaker had reconsidered his wish to enter a career for which he would receive a large income. Instead, he considered the use of food growing as a way to reconnect people with their food and encourage healthier food choices.

A lot of students appeared to respond by reflecting that they should change their own diets to eat healthier but were also intrigued by the speaker's journey. Some reflected that his experience at university had been important to his outcomes, others, his passion. A number of students had never thought about starting their own business, or how their future careers could help the environment. The talk heard by the students provoked many varied emotional responses. Whilst there were those that left the talk disinclined to think of the subject matter again, others thought about what subjects they were interested in and perhaps their work ethic. A notable number left feeling inspired to take specific action to address prominent themes heard during the talk. Themes stood out differently to students, and each student formed a hierarchy of what they felt was important from what they'd heard.

Theoretical sensitivity

The data provides only a snapshot into how students responded to a talk about sustainable agriculture. How they received the information could have been affected by parental belief, culture, socioeconomic situation, ethnicity, religious belief or gender, amid other factors. Additionally, hearing the talk amongst their peers in the context of a school assembly could have affected how the information was received. Finally, factors affecting a student at that specific moment in time could have affected their response to the talk.

The data was considered under the following assumptions:

- It is unlikely that many students will know how damaging conventional agriculture is to the planet.
- It is unlikely that many students will have heard of urban farming solutions to future food problems, in particular aquaponics.

Subsequently, the following questions arose from reviewing the data:

- Many students may view this to be a 'science' or 'adult' problem - who are students relying on to solve future food problems?
- Many students will have a limited experience of having control over their food choices – do they wish to have more control?
- How interested will students be in this topic?
- What will their emotional response be, considering that this is difficult topic that talks about existential threat in the future?
- To what extent can students access food that has been grown in a sustainable way?

Open coding

To consider the research question, the data was collected from Farm Urban, as all feedback forms were anonymous. The forms were handwritten and this raw data was processed into an excel document. The TEDx talk took place in a whole year assembly at ten schools. Students answered 3 questions in open response boxes:

1. What did you take away as the most important message from the talk today?
2. In what way does this message inspire you personally when you think about your future?
3. How has today helped you to think about your future goals and the steps you plan to take to achieve them?

Additionally, four Likert scales including the categories 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree' and 'strongly agree' were provided to respond to the following statements:

1. I feel inspired to find solutions to the 'big' problems that I care about.
2. I am interested in learning new information and skills.
3. I feel more confident about what I might do in the future.
4. I have a better understanding of how studying at university could help me to achieve my goals.

As the raw data was processed, respondents were assigned a number (respondent 1, 2, 3 etc). The answers were reflected upon whilst typing up the raw data, and subsequently read through again to consider the themes emerging from the data and answers were grouped. Once all themes were explored, similar statements were

placed together within the groups to form codes. Where a statement did not fit within a code, a new code was established to provide nuance to the themes, unless the statement was unique and did not bear any correlation with the question asked, in which case it was coded as miscellaneous. A code was also provided for answer boxes that were left blank. A codebook was created to document coding decisions and ensure consistency throughout open coding.

Axial coding

Open codes were extensively examined to establish relationships and further categorise the emerging concepts. It was evident that students were adopting strategies to process the information from the TEDx talk and to understand who was responsible for causing and solving the existential threat to the environment. Through examining the use of personal pronouns, the codes were further dimensionalised to establish where responsibility was being placed:

Individual response: a respondent has identified that they are personally going to act, or have personally had a reflection based on the TEDx talk. E.g. ‘I will grow my own food’, ‘I feel optimistic about the future’.

Immediate collective: a respondent has identified that they themselves and a relevant social group will respond together to a theme arising from the TEDx talk. E.g. ‘my family’; ‘our school’ or ‘our generation’.

Selective coding

The central phenomenon of the data is the response elicited from students when presented with information about an environmental topic, in this case the unsustainability of conventional agriculture. The core concepts, which were established through selective coding to elucidate the central phenomena, were:

Action responses: a respondent has identified an action that could be taken. E.g. ‘I could exercise more’, ‘we could recycle’.

Reflective responses: a respondent has identified their attitude or outlook relating to a theme. E.g. ‘I feel grateful’ or ‘I feel uncertain about the future’. Alternatively, a respondent has recognised a societal group that they are not necessarily a part of. E.g. ‘the food industry’, ‘Farm Urban’, ‘the government’.

Teacher interviews

Whilst the TEDx talks served to provide data concerning student responses to environmental education, the research question also seeks to understand the facilitation of environmental education through an EdTech tool. As discussed, initially data to understand the use of the EcoVerse EdTech tool was to be obtained through feedback forms provided by students throughout the Future Food Challenge. As the Future Food Challenge could not be completed due to the COVID-19 pandemic, instead, teachers were contacted who had facilitated the challenge to ask if they would be interviewed regarding their experience of taking part in the

programme. Despite the busy schedules of teachers who were adapting to educating students from home, three teachers responded, and interviews were conducted.

The interviews explored the following questions:

- 1) What impact does Farm Urban's 'Future Food Challenge' have on teachers' delivery of environmental education in Merseyside secondary schools?
- 2) How have teachers used Farm Urban's EdTech tool to deliver environmental education in Merseyside secondary schools?

Three semi-structured interviews were conducted with participants 1, 2 and 3. The interviews were conducted through Zoom, after teachers had been provided with participant information sheets and consent forms. Teachers were also given a list of questions in advance of the interviews.

With consent from teachers, the interviews were recorded and transcribed. The transcriptions were uploaded onto NVivo, and read through several times. Open coding was conducted by paragraph, using in vivo codes. The codes were reviewed and either merged or broken down further. Each interview was then reviewed using the same codes, to establish teacher responses to similar issues. As there were only 3 interviews compared to 1,204 TEDx talk responses, a less complex coding strategy was employed to analyse the teacher interviews, and instead, a thematic analysis was conducted to elucidate the experience and reflections of teachers concerning their participation in the Future Food Challenge.

The next chapter will explore the first cycle of research, and explore the process of developing EcoVerse's EdTech product.

4.4 References

Boulianne, S., Lalancette, M., Ilkiw, D. 'School Strike 4 Climate: Social Media and the International Youth Protest on Climate Change' *Media and Communication*, 8(2), pp. 208-218.

Bush, D., Sieber, R., Seiler, G., Chandler, M., Chmura, G., (2019) 'Bringing climate scientist's tools into classrooms to improve conceptual understandings' *Journal of Environmental Studies and Sciences* 9(1), pp. 25 - 34.

Clarke, L., and Agyemen J., 'Is there more to environmental participation than meets the eye? Understanding agency, empowerment and disempowerment among black and minority ethnic communities' *Area*, 43(1), pp. 88-94.

Kotiranta, A., Tahvanainen, A., Kovalainen, A., Poutanen. S., (2020) 'Forms and varieties of research and industry collaboration across disciplines', *Heliyon*, 6(3), pp. 1-18.

Life Changes Trust (2020), 'Action Research' available at <http://www.lctevaluationtoolkit.com/action-research>, accessed on 1 September 2020.

Nesta (2019), 'Testing innovation in the real world', available at <https://www.nesta.org.uk/report/testing-innovation-real-world/>, (accessed 3 July 2020)

Outhwaite, L., (2017) 'Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children' *Computers & Education*, Volume 108, pp. 43 – 59.

Skillsbuilder Partnership (2020) available at: <https://www.skillsbuilder.org/>, accessed on 30 July 2020.

Somekh, B., (2006), *Action Research a methodology for change and development*, (Open University Press), accessed through the University of Liverpool Catalogue, pp. 1- 226.

Teach the Future, (2020) 'Asks', available at: <https://www.teachthefuture.uk/hub/44e33423-98c7-4882-9e7f-81c8fd450722>, accessed on 2 July 2020.

Thomasson Goodwin, J., Goh, J., Verkoeyen, S., Lithgow, K., 'Can students be taught to articulate employability skills?', *Education and Training* 61(4), pp. 445-460.

Van Dijk-Wesselius, J.E., Hovinga, D., Maas, J., van Vugt, M., van den Berg, A.E., (2018) 'The impact of greening schoolyards on the appreciation, and physical, cognitive and social-emotional well-being of schoolchildren: A prospective intervention study', *Landscape and Urban Planning*, 180, pp. 15-26.

Wiesche, M., Jurisch, M., Yetton, P., Krcmar, H., 'Grounded theory methodology in information systems research', *MIS Quarterly* 41 (3), pp. 685-701.

Willis, J., and Edwards, C., (2014), *Action Research: Models, Methods and Examples*, (North Carolina : Information Age Publishing), accessed through the University of Liverpool Library Catalogue, pp. 1 – 343.

5. Developing the EcoVerse Product

5.1 Research cycle 1: Understanding the Future Food Challenge

Cycle 1 of this research included further contributions to the literature review, which has been discussed in chapters 2 and 3. The literature review discussed the global plight in terms of climate change, and the UK national context for how the state and the UK population are responding to the need for action. This research has been based in Liverpool, having been conducted by the University of Liverpool, and with schools across Merseyside taking part in the Future Food Challenge. Liverpool is a vibrant city, home to four universities, two premier league football teams and has UNESCO world heritage status. Conversely, Liverpool is also the 3rd most deprived local authority in the UK, the 3rd most deprived in terms of health deprivation and disability and the 5th most deprived in terms of employment (Liverpool City Council, 2019).

Liverpool City Region was selected as one of six Centres for Offshore Renewable Engineering (CORE centres), and now hosts the world's largest wind turbines (Liverpool City Region Local Enterprise Partnership, 2020). There have also been several significant projects to promote sustainability such as the Alder Hey children's hospital building, which has been built to produce 60% of its energy onsite; and the River Alt restoration Project, which led to improved water quality through river realignment, and the planting of 2,000 trees (Liverpool City Region Brussels Office, 2017). However, whilst Liverpool was selected as a CORE centre and strategically planned to develop a low carbon economy, North considers that:

While perceptions of what a low carbon economy could look like in Merseyside did receive attention, at a basic level there was no change from conventional perceptions of local economic development (North, 2010).

Since North's statement, global climate strikes and the declaration of a climate emergency by many councils including Liverpool have changed the landscape for environmental action. Many local and national governments are now committing to investing in low carbon industries and building a 'green collar' workforce (Department for business, energy and industrial strategy, 2019). However, with the continuation of socioeconomic disadvantage across many areas of Merseyside, it is important that environmental education engages with citizens of the city to understand how sustainability can be instituted into Liverpool's daily life, and as a means to ensure genuine and inclusive local economic development. As discussed in chapter 3, a move towards new industries and technological development requires new skills for an emerging young workforce, and students of Liverpool must be equipped to lead the way in building a low carbon future in a way that empowers all Liverpoolians.

This chapter will focus on the work of Liverpool social enterprises Farm Urban and EcoVerse who seek to equip young people to engage with environmental education through the development of an EdTech tool to host educational programmes for low carbon technologies.

5.1.1 Farm Urban

Farm Urban is a social enterprise based in Liverpool, which in 2019 launched Liverpool's first hydroponic farm. Started in 2013, Farm Urban was born out of the desire to improve health by reconnecting the local community with food grown in a sustainable way. Farm Urban spent the first years of its existence researching and developing food production methods through the use of aquaponics and hydroponics. They designed and built a small aquaponics system called a 'Produce Pod', which uses Ikea boxes and basic plumbing components to house fish and produce plants, herbs and leafy greens indoors. Farm Urban provides open source instructions demonstrating how to build a home aquaponics system. The company continued to test and evaluate different technologies including aquaponics, hydroponic and aeroponic systems, as well methods of microgreen production.

Alongside the research and development of food production methods using the described techniques, Farm Urban additionally developed educational programmes for the local community. Using the Produce Pod, workshops were designed to facilitate various intergenerational groups of people to build a small-scale aquaponics system, with the materials provided but no instructions. Dr Paul Myers, a co-founder of Farm Urban, also delivered a TEDx talk to explore the broken food system and consider the unsustainability of conventional agriculture in an accessible way for the public to understand based on his research in this field. Whilst disseminating research in this manner, Farm Urban additionally began to work extensively with Liverpool Life Sciences UTC – a specialist technical college encouraging science industries to partner with the school for a practical scientific education. Together, Farm Urban and the UTC designed and developed an award winning double helix structure aquaponics system. This collaboration demonstrated the capacity for the organisation to work directly with students to raise awareness about sustainable farming whilst providing practical experience to young people using innovative scientific methods.

5.1.2 Education and outreach

Through the successful collaboration between Farm Urban and Liverpool Life Sciences UTC, a learning lab was developed in the crypt of the UTC building, through which Farm Urban could continue research and development, whilst the students of the UTC could witness the real time progress of the new agricultural methods. Volunteering opportunities were provided for students who could choose to use the agri-lab to learn more about growing crops in water.

Learning from the successful collaboration with the UTC, the potential for interactive learning experiences to problem solve solutions to complex global issues was identified. Subsequently, Farm Urban developed an educational programme to highlight the problem of unsustainability in agriculture, explain the principles of urban farming and provide practical opportunities for students to design and build their own aquaponics system. The programme was not only developed to focus on this aspect of environmental education, but additionally to share Farm Urban's own journey as a start up social enterprise. Resultantly, programme content not only covered the science behind the systems to enable students to build their own, but also incorporated insight into varied components of building a business. This included sessions such as business planning, marketing and design.

The educational product was called the ‘Future Food Challenge’. The challenge aimed to equip groups of up to 15 students with the skills to create their own start up business whilst designing and building their own prototype aquaponics system. Content was provided for the groups to be used during sessions facilitated by their own teacher. This included informational slides, crib sheets for student team leaders, session overviews for teachers and ‘how to’ videos. The content was hosted on a website providing weekly resources. Equipment was also provided for students to build their own functioning Produce Pod to learn from and experiment with throughout the programme in addition to building materials from which students could create their own prototype aquaponics system.

Farm Urban received funding from ‘Shaping Futures’, an organisation who support activities to reduce the gap in higher education participation. The first Future Food Challenge began in 2017. Dr Paul Myers attended 10 schools working with Shaping Futures to deliver Farm Urban’s TEDx talk and tell students about the opportunity to participate in the challenge. Students then applied, and 15 were selected by teachers to form a team. The 150 student participants were invited to a launch day event at the University of Liverpool, completed the twelve-week programme and competed at a final competition for awards including ‘best business’ and ‘best product design’. Following the completion of the challenge, the students supported Farm Urban to deliver the aquaponics workshop (building the Produce Pod with no instructions) to their peers across year 9.

5.1.3 The Future Food Challenge

As discussed in the literature review, there are many different stakeholders shaping the UK education system. Many themes that arise from the literature review are of direct relevance to the Future Food Challenge and what the programme is trying to achieve.

It was identified that the national curriculum covers environmental education implicitly in many of the topics that are explored. For example, the sciences explore the uses of fossil fuels and how the release of greenhouse gases contributes to global warming. What is lacking is the context of anthropogenic climate change across all curriculum subjects, and how students can understand how they personally relate to, and can participate in, structural change to meet global environmental needs. The multi-subject focus of the Future Food Challenge is a helpful example of the relevance of various subjects to addressing climate change. For example, the content of the programme explores food, design technology, business, science, graphic design and more. The ways in which the programme utilises themes outlined in the national curriculum is outlined in appendix 1.

Despite content relating to environmental education being present in the national curriculum, as discussed the content does not explicitly consider the extent to which unsustainable practices are built into our everyday lives. To uncover the ways in which we individually and as a society could be more sustainable, students require direction, yet chapter 3 explored how many educators do not feel trained or equipped to teach environmental education. The Future Food Challenge seeks to equip teachers to learn about a sustainable technology alongside students without the need for prior

knowledge themselves. Teachers facilitate the class, however the programme is designed to be student led, with all necessary content provided.

The Future Food Challenge provides context for all students, years 7-9, through the TEDx talk which is delivered in assemblies to each year group. A continuing reminder of the themes discussed in the talk are provided for students at the school, as a Produce Pod is provided for students which most often schools choose to keep in science classrooms or the school foyer. Students are able to see, perhaps daily, the fish in the Produce Pod and different plants growing and being harvested. This could be considered to be an important aspect of subliminal learning arising from the TEDx talk, as the themes of the talk - growing food locally, reducing food miles, using fish waste and recycled water in an integrated food growing system - are made real for students as they see this in action.

It was discussed in the literature review that a successful pedagogical method was to incorporate students into real world scientific discovery. This was a useful pedagogical method for several reasons: it placed scientific research in context; it could potentially be an opportunity for students to see scientists from similar backgrounds to themselves; and it was considered that through the practical application of scientific skills, students gained a deeper understanding of subject content. Having collaborated with students on the double helix project, and subsequently installing an agri-lab in the crypt of the Liverpool Lifesciences UTC school, Farm Urban's design of the Future Food Challenge continued to incorporate the practice of collaborative working with students. For example, on the launch day of the project, a session entitled 'speed-date a scientist' provided students with the opportunity to meet scientists working in Liverpool.

Consideration of who was involved with the project was a significant aspect of the Future Food Challenge. In both the TEDx talk, and events such as the launch and competition days, the multidisciplinary nature of the team was highlighted to students. Farm Urban staff and volunteers have included biological scientists, computer scientists, botanists, English graduates, engineers, workers in hospitality, and other varied backgrounds. Through the content of the sessions, and meeting the Farm Urban team, students learnt how different people had used their varied skills to contribute to Farm Urban's work in unique ways.

The literature highlighted a pedagogical shift in the context of a future changing through technological development. Some educators are seeking to prioritise the development of skills in addition to the transfer of knowledge. Through a collaborative programme such as the Future Food Challenge, students are able to develop a number of hard and soft skills. They are learning the specialist knowledge of how the nitrogen cycle relates to the aquaponics cycle, and how to apply this knowledge to build a functioning aquaponics system. However, to fulfil the aims of the project, which operates on a tight deadline, students must also develop their skills to work as a team, communicate their idea as a 'pitch' to a panel of judges and innovate a unique idea.

Farm Urban have deliberately incorporated the use of business tools, which are unlikely to have been used by the students before. These include:

- Asana – a team project management tool
- Slack – a team communication app
- Gantt charts – a project management method using Microsoft Excel
- The Future Food Challenge online platform – to navigate for instructional slides, videos and other information.

As discussed, the use of technology can be considered to be an ‘add on’ activity without appropriate context for its use in lessons. However, by utilising tools in the sessions in a way that replicates how a business may project manage or communicate, students are developing their digital literacy whilst fulfilling the aims in the project. They could additionally find the use of such tools to be helpful for job applications or in a future job role.

Farm Urban’s use of EdTech in the pilot Future Food Challenge was thus implemented in two ways. Firstly, a website was used to provide the required content and resources for the programme to be delivered. Secondly, other app-based or online tools were used to bring business technology into an educational context.

The organisation Nesta worked in partnership with the UK government to provide funding for EdTech ‘test-beds’, as it was identified that there was a disconnect between EdTech industry developers and teachers (Batty et al, 2019). This led to the development of products, which, whilst impressive, were not functional in the classroom. Farm Urban is in the unique position of being located onsite with a school, and therefore being able to trial new resources with students and teachers before developing an EdTech product.

An important aspect of environmental education was identified as providing students with the information that they need about climate change without fuelling eco-anxiety and disillusionment. Farm Urban’s content does not shy away from the catastrophic nature of climate change, nor ignore the fact that our actions must change to be sustainable. However, by equipping students with knowledge of the reality of food insecurity, whilst giving practical advice and teaching students to produce a tangible product for sustainable food growing, Farm Urban are equipping students to have hope and take ownership for solving future food problems.

At the end of Farm Urban’s first year running the Future Food Challenge, they were successful in receiving further funding from Shaping Futures to deliver the project for a second time. At Farm Urban’s inception was the desire to connect local people with locally grown food. A relationship quickly developed with Liverpool Life Sciences UTC, which demonstrated the benefits of colocation. After the subsequent successful delivery of the Future Food Challenge, Farm Urban had clear goals for what they wanted to achieve for their education programmes.

Through the use of the website, it was envisaged that an evolved platform could be a useful host for not only a wholly online Future Food Challenge but also other EdTech resources aimed at facilitating low carbon initiatives. However, this was a large project outside of the immediate remit of Farm Urban. As such EcoVerse was formed as an educational company, which could partner with Farm Urban and other organisations to facilitate environmental education, with a low carbon focus.

EcoVerse received funding to develop an online platform suitable for hosting educational content such as the Future Food Challenge and used the approved supplier IGOO for web development services. Through a partnership with the Low Carbon Eco-Innovatory, EcoVerse sought to develop the online platform in partnership with the University of Liverpool and Farm Urban as an action research project.

5.2 Research Cycle 2: Designing an EdTech Tool

5.2.1. The Project Brief

To build a platform suitable for hosting educational products such as the online Future Food Challenge, EcoVerse developed the following design brief:

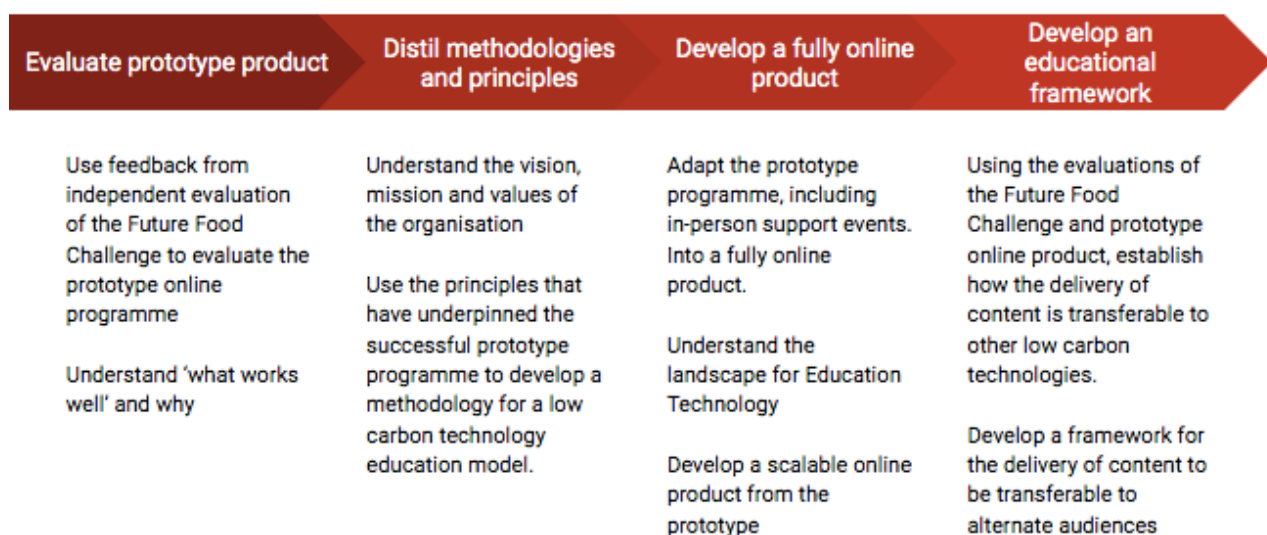


Figure 8

The outcomes of this research project were envisaged to include:

1. Determined user requirements to facilitate digital solutions.
2. A methodological framework for the platform to host multiple low carbon technology educational programmes suitable for varied audiences.
3. Evidence of the potential for this product to inspire students and affect their attainment in school, desire to study science and to pursue the development of low carbon technologies as a future career path.

5.2.2 Evaluating the Prototype Product

To understand the Future Food Challenge and how it may be transferable onto an online programme, the existing product was explored using different approaches. Both interactive content provided by the Future Food Challenge's website and written evaluations of the piloted Future Food Challenge were reviewed, and the researcher volunteered with the Farm Urban team.

Project administration

As Shaping Futures funded the project, schools that were eligible for Shaping Futures' funding were the key schools recruited by Farm Urban for the second Future Food Challenge, and ten schools were recruited. The UTC Life Sciences School were offered a place on the programme as part of the on-going partnership between the school and Farm Urban. An additional place was offered to a school for students with special additional needs after a teacher from the school had shown interest in Farm Urban's work.

Schools were asked to sign up using Google Forms, and registered onto the programme where they received introductory documents and an invitation to a Teacher Training Day. The first step for teachers was to use a 'doodle poll' (an online polling tool) to select a date for Farm Urban to deliver their TEDx talk into a school assembly. After students listened to the talk, they provided feedback forms for Farm Urban, and were given application forms to apply for the Future Food Challenge. Teachers were advised to select 12- 15 applicants for the team, as this was a big enough group to complete the tasks necessary during the challenge, but small enough to ensure group cohesion, and ensure that each student must participate for the sake of the whole team. The evaluation of the first Future Food Challenge discussed teacher perception of team selection. Teachers stated the following:

"You can't think only in terms of the individual but in terms of giving the group the best chance to succeed." (Taylor, report 5, p. 13.)

"It is also sensible to eliminate [from the selection process] someone who is not only highly opinionated, but who you judge is incapable of listening or taking into account the views of others". (Taylor, report 5, p. 13.))

It is evident that the sessions needed to be enjoyable and functional for both the facilitator and the students for the project to be successful. For the purposes of this project, success could be defined as student awareness of sustainable food messages; the students' building of a prototype aquaponics system; the development of essential skills; and students being inspired and passionate about this field of work and study. However whilst success for the project was desirable, it was also important in respect of Farm Urban's mission for the education programme to make it accessible for all students. Therefore, Farm Urban requested that whilst teachers tried to choose a cohesive group, a number of spaces were provided for students who would not usually participate in extracurricular activities, or even in the classroom.

Teachers were able to complete registration activities through the website, but emails were also sent to remind teachers of the actions required to book onto Future Food Challenge events.

Launch events

After the schools' TEDx talk assembly, two launch events were provided for teachers and students:

1. Teacher Training Day
2. Launch Day at the University of Liverpool

From the initial evaluation it is evident that these events were successful. Many questions were analysed from student feedback forms, demonstrating information such as the ‘speed-date a scientist’ event being the most popular. The evaluator considers that the popularity of this session may have been due to the fact that students took the lead in this session: ‘This session put the students on centre-stage, enabling them to set the agenda by asking the questions they had chosen’.

A statistic to sum up the result of the day showed that using a Likert scale from strongly disagree (1) to strongly agree (6), asking how excited students were to start the Future Food Challenge, the mean score for students was 5.2 (page 91).

Furthermore, feedback from teachers concerning the Teacher Training Day demonstrated a similarly successful day, with teachers feeding back a 94% average score about their level of confidence in the initiative. Such positive results from the 2017-18 launch events demonstrated the value in holding the same events for the 2018-19 Future Food Challenge.

Communication

Two methods of communication were added during the 2017-18 FFC for both students and teachers. Farm Urban set up a ‘Zoom room’ for teachers whereby they would host an online video chat at a set time each week for teachers to attend with questions. Whilst the evaluation demonstrated that teachers found this option to be a good idea, in reality other pressures and meetings meant that teachers were not always able to attend the Zoom room. However, it was evident from the end of programme evaluation that teachers did still feel able to contact Farm Urban, even if they were unable to use the Zoom room:

“The level of support was the very best that I have ever had from any externally funded project I have worked in.” (Taylor, report 5, p. 35).

The students, through the FFC website, were provided with a forum via which they could interact with both Farm Urban and other schools. However, Farm Urban noted that the students did not use this as much as they expected. Teachers explained that this was largely because they did not want to ask questions in front of other students. Additionally, they were more familiar with asking their teachers for answers to their questions, rather than seeking answers externally (Taylor, report 5, p. 21).

Due to the difficulties with both Zoom and the forum, for the 2018-19 Future Food Challenge Farm Urban instead decided to use the programme ‘Slack’, a communication programme that was already used regularly by the Farm Urban team. Slack enables both group messages and direct messages, and is a similar format to communication programmes such as ‘Whatsapp’ or ‘Messenger’. Farm Urban set up separate Slack ‘workspaces’ for both teachers and students to contact Farm Urban. As a volunteer for Farm Urban during this time, it was evident to the researcher that this tool was used by more schools than had previously communicated via the forum, but emails continued to be the contact method of choice by teachers.

Farm Urban's Future Food Challenge

Name: _____

How would you rate yourself right now for each of these skills?

How proud I am of the progress I have made during the challenge. How do I feel about the progress I have made during the challenge. How do I feel about the progress I have made during the challenge.

Choose 2 skills that you would really like to focus on improving during the project. Write your 2 skills and target marks at the bottom.

Resilience /10

Communication /10

Teamwork /10

Leadership /10

Problem Solving /10

What's your skill set?

Focus skill 1 _____ Target score _____ Focus skill 2 _____ Target score _____

Student self assessment

Farm Urban's Future Food Challenge

Skills Scorecard: Week _____

Skill / Attribute: _____ Students (Initials): _____

1. Working Well in a Team

Willing to listen to others

Willing to share ideas

Encouraging others

Strong team to encourage

Taking on a fair share of the team's workload

2. Leadership

Understands own strengths and weaknesses

Appreciates strengths and weaknesses of others

Motivates others in team

Keeps things on track

Gives everybody a chance

3. Giving Constructive Feedback

Is supportive

Is positive

Is helpful

Shows kindness

4. Is a Good Communicator

Presents ideas clearly

Is willing to listen

Thinks about the needs of the audience

Shows confidence

5. Willing to Take on Responsibility

Willing to go the extra mile for the team

Teacher assessment tool

Farm Urban's Future Food Challenge

Student Name: _____ School: _____

What do you know about aquaponics?

You could think about the science; the technology and engineering; sustainability and the environment; food and health.

Student mind maps

Figure 9 – assessment resources

Assessment and Self-appraisal

Farm Urban implemented a series of assessments to be completed by both the teacher and student about student progress (figure 6). According to the evaluation, when self-assessing, students were likely to score themselves very highly on their own skills. A teacher identified the students as ‘novice self-evaluators in a college where high marks were prized’ (Taylor, report 6, p. 11). Mind maps were also used, at the start and end of the 12-week programme, and proved to be an arguably more useful and interesting tool for understanding the range and depth of students’ understanding of the topics explored during the Future Food Challenge. Interestingly, it was noted by the evaluator that students with limited mind map knowledge at the beginning of the programme were less likely to engage with the challenge for a full 12 weeks.

Comprehensive scorecards were provided for teachers to fill in for students, identifying how they had progressed during each session. Teacher feedback suggested, however, that it was difficult to map the progress in each area of assessment for each session, as there was not always an available chance to demonstrate certain skills (Taylor, report 5, p. 29). Additionally, the cards were time consuming to fill in during an already packed programme.

It was clear that the teachers felt that the programme implicitly provided many and varied opportunities for students to develop their skills. One teacher commented that:

“If we were to say ‘okay this session we will develop leadership’ and then there was a particular activity for that, that would switch them off” (Taylor, report 5, p. 8).

However, the literature review highlighted that students can be hindered by an inability to articulate their skills, not only in university and job interviews, but also by limiting the types of jobs that they feel that their skill set matches. The teacher describing students ‘switching off’ when being told that an activity would develop their leadership skills suggests a negative response to a seemingly contrived activity.

Another teacher commented of the Future Food Challenge: “This is an authentic experience. There is nothing artificial about it” (Taylor, report 5, p. 5). It is therefore evident that it is important for Farm Urban to get the balance right within their content between the need for students to be able to articulate their skills and learn how to apply them across other areas of their lives, and continuing to ensure the authenticity of the programme.

By bolstering the process of self-assessment, and equipping students to be aware with greater depth of their skill development, much like when students responded positively to having agency in their interaction with the scientists, students can feel empowered to achieve their own learning. The evaluation reflected that:

‘More care and attention is needed in the first session to give students the guidance and support necessary to make a realistic assessment of their skills before embarking on the Challenge.’ (Taylor, report 6, p. 42.)

The evaluator recommended that scoring for assessment would benefit from broader based categories, assessment once a month from teachers, and qualitative as well as numerical assessment. It is apparent therefore from the 2017-18 FFC that there was a clear call for further investment in equipping students to practice self-assessment.

Weekly Sessions

As described above, content was provided for the students in the form of weekly sessions. This included slide shows, crib sheets, links to Farm Urban’s videos and resources such as example technical drawings

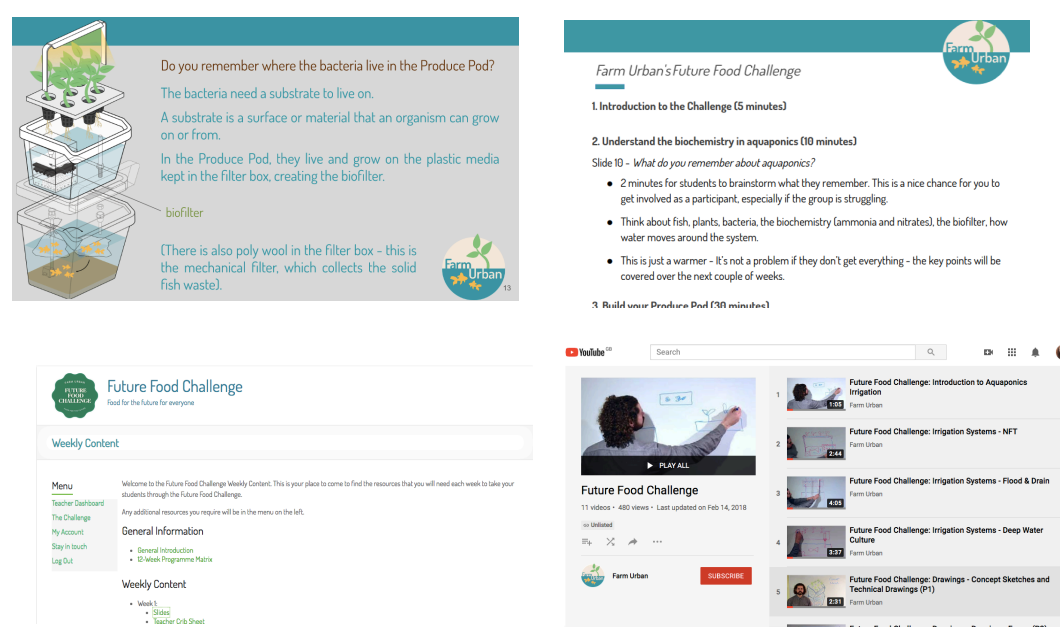


Figure 10 – Farm Urban’s Future Food Challenge website

Whilst facilitators and students responded well to the content provided and the opportunities awarded by the challenge, it is evident that there is much more content available to get through during the challenge than will possibly be achievable during the sessions alone. It is clear from the evaluation that teachers felt well resourced, but preparation for the class was required to ensure that the teachers understood the most necessary objectives for the session and could guide the class accordingly. For this reason, teachers highlighted that it would be helpful to know what must be achieved each week to progress through the challenge, and which activities were for further development that the students could potentially do in their own time. Teachers did not wish to hamper student creativity, yet needed to keep students motivated to keep on track with the tasks and ensure that they were making progress. Indeed, many students

were happy to spend extra time on the project outside of the sessions because they were enthusiastic about it.

During the sessions, students are often asked to carry out research, for example, finding out about different aquaponics systems or brand information. Teachers described how this was not a usual method of learning for students in year 9: “Farm Urban had prepared resources – short videos, web links – and they did use them, but for some they are so used to textbooks which are written to tell them the full story. Sometimes a web link doesn’t fully answer the question, and they find problems coping with that...” (Taylor, report 5, p. 21).

This is a valuable aspect of the programme, as not only are students completing research in academic forums, for example for the purpose of preparing an academic poster, but also finding out the parts, components and cost of systems as well as the benefits and disadvantages. As finding and comparing quotes for parts and services, as well as operating within a budget, is an important everyday skill, students are becoming used to research methods that will benefit them as both life and academic skills. Feedback demonstrating that web research is not as common a research method as the use of textbooks further evidences the information from the literature review that the use of technology in school is significantly behind that which technology is used for outside of the classroom. This demonstrates that this is an important aspect of the programme, but that students need more guidance to successfully complete web research.

Teachers were pleased that throughout the Future Food Challenge, they saw the development of the students’ social skills as they worked in a team. Individual students could struggle to find their place, but one case study suggested from the evaluation that a student’s interest can be captured when they realise their niche as opportunities continue to arise through the programme, for example when a student realised that he was actually very good at managing people (Taylor, report 5, p. 39).

The evaluator completed 22 student interviews, and 19 of the participants concluded that the FFC had exceeded their expectations. Following interviews with student participants, the evaluator summed up the benefits that students experienced from taking part in the challenge (Taylor, report 7, p. 7.):

- Building confidence and developing capability for the future
- Team work
- Developed leadership skills and confidence
- Found science enjoyable
- Helped with future study/career decision making

Benefits for the school

The Future Food Challenge requires various commitments from a participating school, and participation will encompass various benefits. Schools need to release one or two members of staff for up to three days across the school year (Training Day, Launch Day and Competition Day), up to fifteen students on two days and all year nine students and supporting staff for half a day. Facilities also need to be available to the team after school once a week for twelve weeks. The school benefits from the

TEDx talk being delivered to three whole school years as well as all year nine students taking part in the Aquaponics Challenge. The team of students and the teachers involved, as discussed, experience many benefits from taking part in the programme. The school is able to exhibit both a Produce Pod and their team's prototype aquaponics system, and can win awards from Competition Day, which can be promoted by the school. A student interview highlighted that this was an aspect that students could take pride in:

“When you do it [the Challenge], you actually feel like you’ve done something today. You’ve helped the school a bit, because it’s going to show the school up a bit.” (Taylor, report 7, p. 11.)

Some students have additionally entered their prototype aquaponics system into the Big Bang Fair competition (a UK competition for STEM projects), and progressed from the North West regional final to the national finals. For schools that are part of the Eco School programme, the awareness raised for students across different year groups about sustainable farming, and learning to design and build an aquaponics system can contribute towards gaining their Green Flag Status. Whilst there are student and teaching union calls for environmental education, the Future Food Challenge serves to empower teachers to feel confident teaching environmental education.

The evaluation also suggests as a future measure that it could be helpful to give Newly Qualified Teachers the option to facilitate the challenge. This could be beneficial, not only for building up an NQT's portfolio, but additionally by introducing the pedagogy, environmental learning across the curriculum and skill development opportunities awarded by the programme to teachers at the beginning of their career.

To promote support for the facilitating staff during the Future Food Challenge, the evaluation suggests that regular communication should be maintained between staff and senior management to keep them updated of the team's progress. Ensuring that all relevant school facilities are used, and involving staff from other departments is also helpful for raising the profile of the challenge across the school. This is important, as discussed above, for promoting environmental education in subliminal learning for students – recognising that their school is facilitating environmental programmes and witnessing the success of peers designing and building a system of benefit to the environment themselves.

The evaluation was a detailed, useful resource to understand the strengths of the pilot Future Food Challenge as well as areas that could be improved.

5.2.3. Distilling methodologies and principles

The researcher initially shadowed the Farm Urban team to understand the ethos of the organisation and therefore what were the main beliefs and attitudes behind the project brief. This included an induction to the organisation and to the vision, mission and values of Farm Urban:

‘Our vision is to create a model of socially-transformative, community-embedded urban farms and education programmes as a means of empowering and reinvigorating communities: building food networks, filling homes with fresh food and creating engaging and meaningful jobs.

Farm Urban’s mission is to grow food that’s good for people in ways that are good for the planet.

Our Values:

- People - we work for the benefit all people
- Planet - we strive to work in harmony with nature
- Purpose - we act with belief, commitment and integrity
- Performance - what we do, we do well
- Passion - we do what we do because we get up every morning believing it needs to be done’

In shadowing the organisation for two months before commencing further research, the following activities were attended, outlined in table 3.

Event	Description
Farm Urban weekly team meeting	Each Monday morning, the Farm Urban team meets to discuss their reflections from the week before and to plan their goals for the week ahead. This included Farm Urban’s three directors, the head grower, two PhD students, two interns, and a beekeeper designing educational material.
Farm Urban monthly team meeting ‘spotlight’	These meetings provide an opportunity for a member of the team to feed back in more detail about their work, to inform, plan or share ideas. Topics may include botany, social enterprise, updates in hydroponic technology or wellbeing.
Future Food Challenge TEDx Talks	As the Future Food Challenge 2018-19 had commenced in September, the managing director of Farm Urban was delivering assembly talks to schools across Merseyside competing in the Future Food Challenge.
Future Food Challenge Teacher Training Day	To prepare teachers for the upcoming challenge, the teacher training day included: reflections from teachers who had previously taken part; a practice building session using the same materials that the students would use; information about the programme outline and events; a practice session from the challenge; navigation around the FFC website; and a question and answer session.
Farm Urban/Daresbury Schools Week	Farm Urban partnered with Daresbury Laboratories to provide workshops and an education programme about aquaponics and sensors to primary school aged children.
Future Food Challenge Launch Day	Launch Day included a ‘meet the scientist’ event, a design engineering session and a business skills workshop, hosted by the University of Liverpool.
EcoVerse/IGOO meetings	EcoVerse staff and web developers IGGO met to discuss their vision for the programme.
Farm Urban/Greener On the Outside of Prisons Network (GOOP) meeting	Meeting with Farm Urban, a GOOP representative and two ex-offenders to discuss the adaptation of the Future Food Challenge to an adult audience.
EcoVerse Website meetings	Meeting with Farm Urban’s technical director, a computer scientist, to learn about the existing Future Food Challenge website. The researcher was familiarised with Wordpress and learnt how to use the website and alter content.

Table 3 – Farm Urban activities

Reading the evaluation reports of the pilot Future Food Challenge, and shadowing Farm Urban and EcoVerse, supported the development of an in depth understanding of Farm Urban, EcoVerse and the Future Food Challenge for secondary school students, which would be the first programme to be hosted by EcoVerse. The following principles were observed through research activity, which underpinned the educational programmes.

- **Collaboration between industry and education**
 - Empowering students to develop their scientific practice using a project of current relevance.
 - Disseminating novel scientific research to students in real time.
 - Empowering students to use their creativity and enthusiasm to contribute to scientific research and technological development.
- **Skill development**
 - Empowering students from all backgrounds to develop confidence and skills for their future.
 - Demonstrating to students that many skills can be applied to developing a low carbon technology and that there are a breadth of relevant skills such as good teamwork and leadership.
- **Social enterprise**
 - Demonstrating to students that careers can exist outside of prescribed professional norms.
 - Equipping students with insight as to what is involved in starting a business.
- **Care for the individual**
 - Wishing to culturally change workplaces to allow team members to pursue what they are passionate about.
 - Allowing space for the discussion and facilitation of ways to enhance the wellbeing of team members.
 - Translating workplace principles into educational activities, and replicating the principles of wellbeing and the value of individual strengths and skills sets into educational team challenges.

Developing further resources

Reading the content of the Future Food Challenge, it is clear that the material is of a high quality in both providing high level knowledge in an accessible way for students, and providing opportunities for students to develop and trial a range of skills. As discussed, when reading the pilot evaluation it was evident that students did not have enough knowledge and understanding of skills to be able to understand where there was room to improve skills further, how to explain their skills and utilise them in different contexts, and how to assess their own skill set.

Resultantly the researcher developed further resources that could be provided for students to understand some key skills that were covered in Farm Urban's initial assessments.

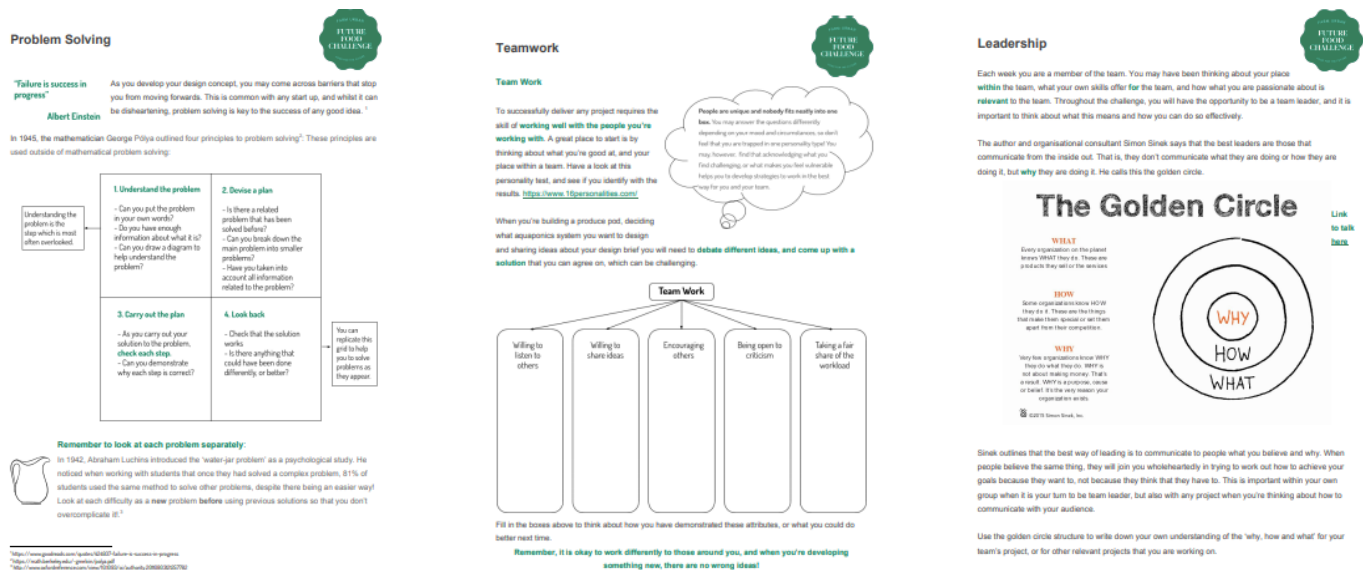


Figure 11 – Skill resources (see appendix 9 for full resource set)

When writing these resources, practical tips were provided for the development of skills, e.g. a template for assessing and presenting the advantages or disadvantages of a system, or a checklist for constructive feedback. However, based on the principles described that Farm Urban was instilling into the Future Food Challenge material, the resources were also used to reinforce key messages to explain the reasons why each topic and skill was being explored and developed.

This involved using influences that had been key to Farm Urban's own development as an organisation. One example of this is Simon Sinek's book 'Start With Why'. Sinek theorises that successful companies do not focus on what a good product is, but why an organisation exists in the first place – promoting a values driven business model as the best starting point for product or service development. Sinek's influence on Farm Urban is evident in their educational content, as before the students are asked to think of anything about their design or business, they are tasked with understanding the problem of sustainable agriculture, and thinking about the environment and food in the context of their local community. They are then encouraged to reflect on the vision, mission and values of their organisation and reminded during subsequent product development sessions to reflect on whether the product reflects their core values for their start up business.

In developing the skills resources, in order to distil Farm Urban's principles, the influences on the organisation were made explicit to the students. This could include recommended books, TED talks or links to relevant websites.

Farm Urban had received feedback that some students were eager to learn as much as possible by engaging directly with the Produce Pod, and therefore further resources were developed to give students ideas for investigations that they could undertake with the fish and plants. The Produce Pod investigations were developed using the expertise of Farm Urban's farming team.

Questions:

1. What factors do you think will affect the fish growth rate in your system?
2. How healthy do you think your fish are?

Results:

Fish welfare

Welfare check	Fish 1	Fish 2	Fish 3
Location			
Movement			
Interaction			
Eyes			
Swimming level?			
Scale condition			

If you noticed anything interesting about your fish's behaviour, or any other signs of poor health write them here:

Fish weight

Fish name	Weight of bowl (g)	Weight of bowl with fish (g)	Weight of fish (g)

IF YOU HAVE ANY CONCERNS ABOUT THE WELFARE OF YOUR FISH TELL US ON SLACK.
MAKE SURE YOU TEST THE WATER AND UPLOAD YOUR RESULTS BEFORE YOU FINISH.

Produce Pod Investigations:

Produce Pod Energy Consumption

Research question: What is the energy consumption of the Produce Pod?

Aim: To calculate the energy used by the Produce Pod.

Prediction: Which component in the Produce Pod do you think uses the most energy?

Method:

1. Check the wattage for each of the following electrical components on the Produce Pod
 - > Pump
 - > Fish tank LED strip
 - > Plant LED grow light
2. Determine the number of hours per day that each item is running for.
3. Multiply these two numbers to calculate the daily watt-hours.
4. Electricity is measured in kilowatts. 1 kilowatt = 1000 watts. Therefore 1 kilowatt-hour (kWh) = 1000 watt-hours. To calculate kWh for the system divide the watt-hours by 1000.

Results:

Component	Pump	LED Strip	LED Grow Light
Wattage			
No hours per day			
Watt-hours			
kWh per day			
kWh per month			

Follow-up question: How could you make your system more energy efficient?

Optional extra:

Find out the cost of electricity at your school (pence per kWh) to calculate how much it costs per month to run your system.

MAKE SURE YOU TEST THE WATER AND UPLOAD YOUR RESULTS BEFORE YOU FINISH

Produce Pod Investigations:

Measuring your Seedlings

Research question: How much have your seedlings grown over the past two weeks?

Aim: To transfer plants into the Produce Pod.

Prediction: How many seeds germinated at the same time?

Transferring seedlings into the Produce Pod:

Seeds can germinate at different times, leading to different leaf size and root length. Your plant growth in the Produce Pod will be more successful if your seedlings have germinated at about the same time.

Stratification:

Stratification is a process where you replicate natural conditions for seeds to grow in. Most seeds require cold and moist settings before they will germinate, so a common way to replicate these natural conditions is by placing your tray of seeds in the fridge. If your seeds have not germinated very well on this occasion, you could try again by repotting new seeds into the peat plugs, and rewatering them for several days.

Method:

1. Lay out your seedlings on your workbench.
2. Using a ruler, measure the length of the shoot and of the roots, and the number of leaves. Be careful not to damage the seedlings!
3. Keep a record of your results using the table provided below.
4. Select 12 of the seedlings that are most similar in size.
5. Transfer these 12 peat plugs into the net pots in the floating raft of the Produce Pod.

Over the weeks to come, check on your plants to see the root length of each plant. The water level in the Produce Pod is slightly uneven, meaning that the roots of the plants at the back are likely to reach water more quickly than those at the front. To ensure that your plants grow at a similar rate, you may need to rotate the plants around the system.

MAKE SURE YOU TEST THE WATER AND UPLOAD YOUR RESULTS BEFORE YOU FINISH

Figure 12 - Produce Pod investigations

It is evident from the programme that there is a lot of material to cover, and the three different roles (managing director, creative director and design engineer) encompass different learning outcomes. Farm Urban replicated their own weekly meeting format to encourage students to meet as a full team and ensure that students were benefiting from all of the learning across the three subgroups. All of the topics covered during the challenge are excellent opportunities for the students to learn for their personal lives and future employability. To capitalise on the different learning areas for subgroups and ensure that the knowledge was disseminated and accessible for all of the students, the researcher designed summary sheets. These were provided for each session and the resources discuss the key points for all three subgroups, as well as any whole group activities. As teacher feedback from the evaluation had suggested that students were most used to learning from textbooks, textbook revision pages served as a format for the resources, as this was a format that students would recognise. Each summary sheet included the following:

- 1) Key points for managing director activities
- 2) Key points for design engineer activities
- 3) Key points for creative director activities
- 4) Whole group activities where applicable
- 5) Skills focus – reiterating what skills could have been developed during the session and signposting students to skills passports and resources
- 6) ‘Think!’ section, inviting students to reflect on an element of the challenge, for example, the environmental issues discussed, managing stress and understanding how their skills relate to the project

The summary sheets provided an additional benefit, as each session could be comprised of up to 7 slideshows. If a student or teacher wished to refer back to a topic, it could be difficult to find the content they were looking for within the slideshows, however the summary sheets could contain the content they were searching for, if not providing direction as to where the content could be found.

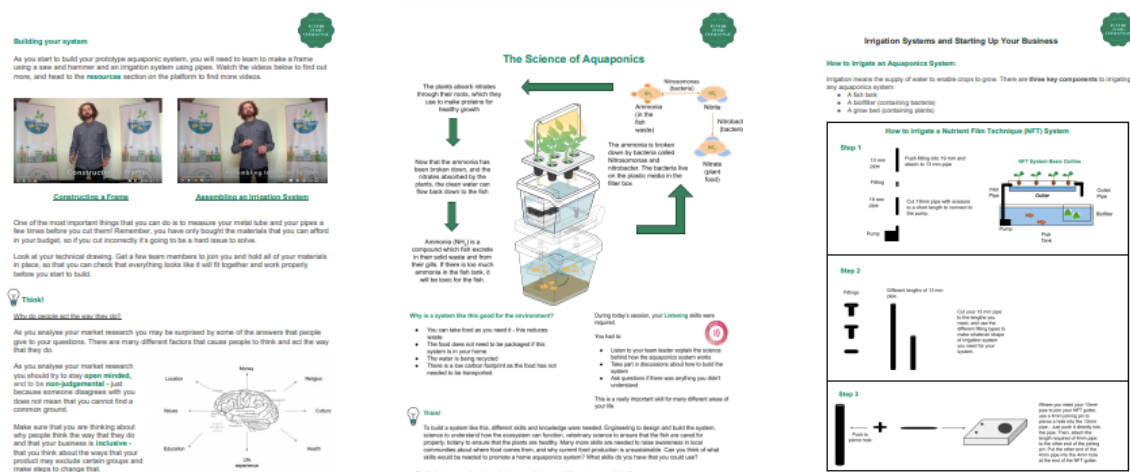


Figure 13 - Summary sheets (see appendix 10 for full resource set)

Due to the timeframe of the programme, which covers a lot of content in 12 weeks, the resources were provided as extras for teachers to refer to should a student be struggling with structuring a task, if a student did not understand the relevance of a topic, or if a student was passionate about the project and enthusiastic about engaging with more elements of the programme. The development of these resources led to the consideration of a modular approach to developing the online tool. Depending on what the user desired from the programme, and the time frame they were operating within, access could be given to different parts of the programme, with resources available accordingly. This would form part of the methodological framework for developing the platform for other low carbon technologies.

5.2.4 Implementing a skills framework

From the pilot Future Food Challenge, skill assessment tools had been established for teachers to use throughout the programme. The categories for assessment included:

- 1) Working well in a team
- 2) Leadership
- 3) Giving constructive feedback
- 4) Is a good communicator
- 5) Willing to take on responsibility
- 6) Problem solving
- 7) Planning and organising
- 8) Self management

Subcategories were also provided to explore attributes in more detail. However, the evaluation recommended that the tool was not suitable for assessment moving forward, as it was too detailed to be able to be utilised effectively by the teacher in each session. The literature review highlighted skills frameworks that were available and used by other organisations. Upon consideration of the available frameworks, the Skillsbuilder Partnership seemed to have distinct benefits for being utilised within the Future Food Challenge and future potential EcoVerse programmes.

The attributes identified by the Skillsbuilder Partnership were not dissimilar to the attributes used in the pilot FFC. The attributes included:

- 1) Listening
- 2) Presenting
- 3) Problem solving
- 4) Creativity
- 5) Aiming high
- 6) Staying positive
- 7) Leadership
- 8) Teamwork



Figure 14 - Icons from the Skillsbuilder Partnership Hub

There were several advantages to becoming a Skillsbuilder partner. Having a common skills framework with other organisations and industries to be able to articulate skills can be helpful for students to promote consistency. The Skillsbuilder Partnership includes over 500 schools, 120 employer partners and 90 impact organisations (Skillsbuilder Partnership, 2020). The language used is accessible, and common to many skills frameworks developed by other organisations, but also ranges from early years to adult learning. This means that as EcoVerse's educational programmes are developed for additional audiences, including primary age and adult participants, the Skillsbuilder Framework can be used across all programmes. Skillsbuilder holds events for members, which raises the potential for EcoVerse to reach additional schools with its developed EdTech product and to share good practice with other industry partners and impact organisations. Finally, becoming a partner means access to many excellent videos and activities to explore different skills through scenarios and for different learning levels.

The Skillsbuilder partnership provides 'Skill Passports' for students, which are designed like passports with a list of the attributes for each skill to be expected at each learning level. The passports provide space for students to record real examples of when they have demonstrated a skill during a session. After a meeting between EcoVerse and the Skillsbuilder Partnership it was decided that the ethos and mission of the two organisations were greatly aligned. The Skillsbuilder Framework was implemented into the Future Food Challenge by incorporating the symbols into sessions to promote the association of different activities with the development of specific skills. The Skills Passports were provided as resources available for students on the online platform.

Finally, an additional new session was developed and provided, to be completed by the participant team at the beginning of the programme, either by students in their own time, or at a launch event. The Skillsbuilder Framework was introduced to teachers at the 2019-20 teacher training day, and received positive feedback:

I'd like to spend more time looking at because they were brilliant. Just a really good way flagging up all the skills that you're developing within the lesson and that, I thought it was really good (Appendix 2).

5.2.5 Working with SEN students

The Future Food Challenge 2018-19 was the first year that Farm Urban was able to work with students with Special Educational Needs (SEN). The experiences of SEN children from school A will be discussed in more detail in the data analysis chapter of this thesis, following an interview with the teacher who facilitated the challenge. However there are developments from the participation of the students of significant relevance to the product development.

The sessions were run differently for school A, as they took place in school lesson time, rather than as an afterschool club. Curriculum and assessment requirements for SEN pupils differ from the national curriculum, and their progress is assessed by P-Scales rather than GCSEs. The sessions were delivered in school A each week, but would often be a morning or afternoon activity rather than an hour long session. Upon discussion with Teacher A, the same launch day activity, session content, competition day and peer workshops were delivered as with all of the different schools.

Teacher A used the session content and adapted it herself according to the capabilities of students in her class. Many activities stayed the same for students in school A as with every other school. Each week a student tested the water chemistry using a dipstick provided by Farm Urban. Students split into groups with different roles, and designed their own system by drawing pictures of what they liked. They monitored the progress of the fish and plants, and smelt, tasted and felt the leafy greens that they were growing. They promoted the use of the prototype aquaponics system as a method of providing food that was not wrapped in plastic, and enjoyed watching or participating in the building of their system.

A key element of the Future Food Challenge for Teacher A was realising that the many students were not able to communicate ideas around the environment, and specifically aquaponics, due to the absence of vocabulary for students with communication aids. School A commonly uses augmentative and alternative communication (AAC), yet symbols were not available for students to use. As such, teacher A liaised with an AAC development company to devise symbols in partnership with her students to represent the ideas being considered in the Future Food Challenge.

Understanding the lack of availability for the communication of environmental concepts was a major learning point from the research conducted throughout the 2018-19 Future Food Challenge, and enhanced sensitivity to the accessibility of the programme, which was considered in the development of the online tool.

5.2.6 Developing a fully online product

The literature review explored the landscape for Education Technology (EdTech) and many lessons could be drawn of relevance to the development of the EcoVerse EdTech Tool. EdTech offers the opportunity to equip students for an increasingly automated age, and also can facilitate pedagogical methods reaching a range of learning styles. However, there are currently both internal and external barriers to the implementation of EdTech. External barriers include many schools having only basic

technological infrastructure, which could limit the amount of computers available to students or high speed Internet to allow connection to EdTech apps. Internal barriers can include previous bad experience of using technology, such as the practicalities of setting up a programme far outweighing the benefits gained from its use. As discussed in the literature review, the government's EdTech strategy has five key aims:

- 1) Administration processes
- 2) Assessment processes
- 3) Teaching practices
- 4) Continuing professional development
- 5) Learning throughout life

The EcoVerse EdTech tool has the potential to meet the EdTech strategy aims in several ways. The aim 'teaching practices' concerns the accessibility and inclusivity of educational activities to enhance learning outcomes. Through the EdTech tool, EcoVerse will encourage accessible content, inclusive of different learning styles. For example, the Future Food Challenge includes practical, creative, scientific and entrepreneurial knowledge and skill development, and through its content covers topics studied under the national curriculum. The potential for the Future Food Challenge to benefit teachers' continuing professional development is evident, for example shifting the pedagogical approach from knowledge passing from teacher to student to both learning together, and incorporating technology into the sessions in an authentic way. Finally, as the Future Food Challenge is developed to reach different audiences, learning throughout life will be achieved through teaching adults new working practices within a green industry, whilst using the Skillsbuilder framework to develop skills and enhance employability.

External barriers to the use of EdTech are common to all EdTech products, as schools need a good IT infrastructure to be able to use products to their full potential. However, the EcoVerse product has proved its versatility as teachers at schools with poorer IT infrastructures have successfully navigated the programme using one computer and a projector, albeit not utilising its capability to the full. Through a 'blended learning' approach, whereby content is hosted on an online platform, yet students are required to complete offline practical activities. EcoVerse has the capacity to overcome internal barriers to the use of technology in the classroom by incorporating technology into sessions without being wholly reliant on it, and ensuring that its use is natural and does not feel forced or contrived.

EcoVerse wants the Future Food Challenge to be available online to enhance the scalability of the product, as the programme was initially limited by the need for much wraparound support from delivery staff. Whilst EcoVerse appreciated that product support would be necessary, they felt that there was much more that could be facilitated online. Initially, I worked with the team to map different ideas for how each element of the Future Food Challenge could be translated into online content. Some of the ideas that were explored are listed in the table below.

Existing activity	Online alternatives
Recruitment	Brochure site, providing information about the programme, demo sessions and free example resources.
Onboarding	All in one place, required documentation,

	checklist with completion dates for steps to be taken by teachers
Teacher training day	An online module guiding through a sample section, video interviews with previous teachers for advice and encouragement, a zoom meeting to meet other teachers and have a question and answer session.
Communication	Automated FAQ session, self-generating with questions from teachers, onsite chat facility, news and update section (twitter feed or other).
Weekly sessions	Timeline for teachers to keep on track, checklist for weekly sessions, places to store work, impact monitoring, host for additional resources from Farm Urban, different access for students and teachers. More interactive/gamified session content.
Launch and competition day	Online packs outlining all of the activities, resources and ideas needed for teachers to host their own launch and competition days. This could be intraschool or interschool.

Table 4 – developing online alternatives

Responding to teacher feedback

Using the independent evaluation, and Farm Urban's own experience of feedback from teachers, the team considered answers to feedback from teachers about challenges that commonly arose during the programme:

a) Support for time management

During the twelve weeks of the programme, particularly with distractions from other pressures in school along the way, it could be easy to lose sight of what the students needed to achieve each week to progress. A first strategy to address this was considered to be a timeline which students and teachers would be able to see upon login. The timeline would indicate where students were in the programme, how far they had already come, and what was left to complete.

The government's EdTech strategy outlined that EdTech initiatives should be focussed on reducing workloads for teachers, and it was important to Farm Urban that teacher preparation could be kept to the minimum possible time to ensure that delivering the project did not put extra pressure on teachers. Teachers had identified in the evaluation that they had to understand the session content to be able to identify the key aims for each session. We therefore produced both a timeline and a checklist for teachers for each session including materials required, objectives, tasks to be completed and indicating optional extras. Whilst we locked content for students to only be able to uncover as they completed their tasks, we decided that teachers should be granted access to all programme content, in case they wanted to look ahead and familiarise themselves with content.

Figure 15 (to the right): each session is accompanied by a checklist of objectives and required uploads of completed work. All of the resources required by teachers or team leaders are listed at the side, as well as a list of required items for the session.

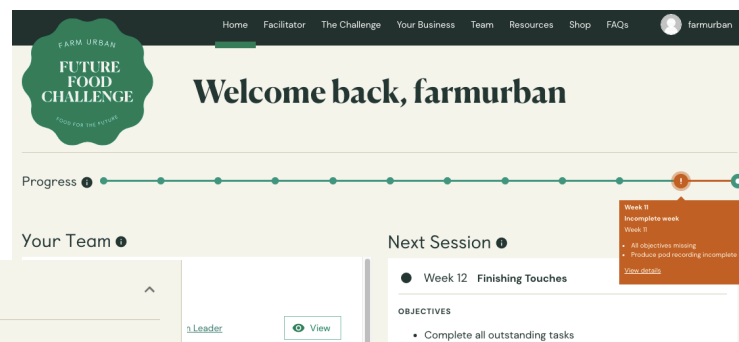
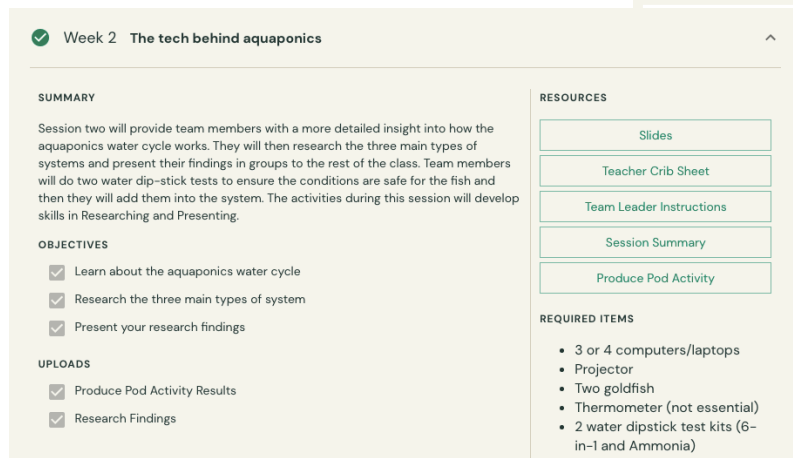


Figure 16 (to the left): the team dashboard includes information about the team, a summary of the next session and a timeline of work completed and due. The orange box highlights work that is outstanding before students can complete their project.

More images from the EcoVerse platform can be found in appendix 11.

b) Simplifying assessment

As discussed, Farm Urban had initially provided comprehensive scorecards for teachers to complete during the Future Food Challenge. Whilst the teachers found the assessments to be a good resource, practically there was not enough time for teachers to document the students' progress in this manner. The evaluation therefore recommended that assessment of student skills used broader categories of assessment. Additionally, as articulated in the evaluation report, the students were 'novice self-evaluators', and marked themselves very highly in their skills at the start of the programme. The use of Skillsbuilder Skills Passports were recommended as resources for this reason, as they enabled students to reflect on specific incidents that resulted in them exhibiting a skill, and showed the progression of different skills according to levels that could be expected by their age. However, to engage the students, it was also viewed that an interactive tool may be appropriate for them to visualise their progress. Influenced by 'outcome stars', which the researcher had experience of using in care work settings, the following tools were developed for students to map their skills and knowledge development as they progressed through the programme.

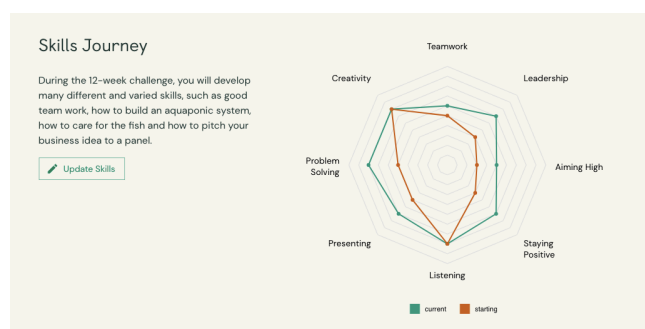


Figure 17 – the skills assessment tool

Instructions were provided for students to think about how they were going to use the tools, and with additional resources such as the introductory skills session, Skillsbuilder resources, indicators of skill development on session content and self-developed skills resources, there was now a more comprehensive 'skills module' for the programme which students were able to engage with should they wish to alongside the programme.

c) Individual accounts for challenge participants

The Future Food Challenge is designed to be a student led programme. As such, on the website that accompanied the pilot programme, there were three accounts for each school: teacher, team leader and student. Each week, a different student would volunteer to be the team leader. The website was designed for the team leader to log on to their account each week, and access their team leader instructions, which would direct them to which slides to read out, when to separate their peers into groups and for any other activities. The student account could then be used during break out activities. However, feedback from teachers suggested that mostly, teachers would log into their own accounts, which would be visible from the front of the classroom, and students where possible would use this account to complete their work. Work was completed on paper, and usually kept in a folder, which could sometimes be misplaced as classrooms were used for other purposes.

Despite teachers choosing to use their own accounts during sessions, feedback from the Teacher Training Day suggested that individual accounts would be preferable for the online platform. This was particularly due to the skill and knowledge tools for students to track their own progress. It was felt that individuals might take more ownership over their role within the project if they could independently view their own progress, as well as all the work being completed by the team. With the additional resources for skill development, as well as existing resources for different subgroups, providing individual logins on a platform accessible on phones could encourage students to log on to their accounts outside of lessons to complete the optional activities.

By incorporating a place for students to save their work on the platform, a benefit of having individual logins with team access is that each team member is able to upload their work. The whole team can view all uploaded work. This provides a backup for work completed by the team, as the work will be stored on the platform, should hard copies be mislaid. To retain the leadership responsibilities of the team leader, key activities could only be completed by the team leader each session, for example, ticking off the objectives that had been completed. This was simple for the teacher, as rather than having a separate account for the team leader, the teacher could highlight which team member was going to lead that week. Similarly this meant that if there were any problems, such as a team leader having to leave the session early, a teacher could either tick off objectives themselves, or quickly assign responsibility to another student using the platform.

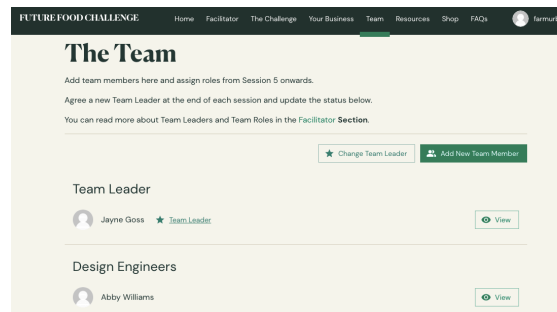


Figure 18– selecting a team leader

d) Platform navigation

The aesthetic of an EdTech tool, and how intuitive it is to navigate is instrumental in ensuring that users will utilise the tool to its full potential. Resultantly, it was important that time was invested in understanding how the user experience could be enhanced through the new platform by understanding the journey they would take through the content and the most logical way for them to navigate through the different materials available.

The EcoVerse team spent time together mapping the journeys of different users that would be accessing the programme, and produced a comprehensive overview of the different access requirements that would be needed by each group.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		August	September	October	November	December	January	February	March	April	May	June	July	
24		Recruiting schools for the challenge: a) contacting former participant schools b) providing info to new schools (directing to FU website and registration form)	Emails to teachers to remind them to book talks	Paul delivers TED Talks, including information about FFC. Shaping Futures data collection forms completed		Confirm and send teacher training date and info	Deliver teacher training: - Overview - Info about Farm Urban - Aquaponics workshop with full system - Troubleshooting	Launch Day: - Welcome - Overview of day		Deliver materials for Produce Pod to School	Farm Urban email reminders about competition day	Competition day - Welcome - Encourage sharing of ideas - Exhibition area - Judging panel for each role of the team - Awards for each team (and roles within teams)	Peer-led workshops delivered. - Farm Urban deliver short talk - work from the competition is displayed	
25		Marketing materials via platform		Info pack including consent forms emailed to teachers		Send Launch Day information to teachers		Live feed, VR tour of FU projects				Interviews completed with teachers for feedback about programme		
26		Demo/taster session available. Limited time access?					Set up email addresses and slack accounts for teachers							
27		Autorenewed access for schools competing again?				Resource pack for in-school launch	Start communicating with teachers on Slack -->	Start communicating with students on Slack -->						
28								Self-generating				Interviews with students for feedback about		

Figure 19 – mapping user journeys

Sections had to be divided logically depending on which user would be accessing which section. Attention was also paid to the language used, as the terms ‘teacher’ and ‘student’ would not necessarily be transferable to a different group for future content to be hosted on the EcoVerse platform. Terms such as ‘facilitator’ and ‘team’ were favoured for this reason.

e) Refining the platform

Once the platform was completed, it had to be checked to confirm that it was fit for purpose. Design choices were reviewed, and IGOO produced more graphics in different colours and dimensions that could be adopted for use in further content. The programme was completed as a student, team leader and teacher to identify if there were any problems with navigation, logical or intuitive reflections about where

which is of relevance to this project was used, the TEDx talk feedback, which will be analysed in chapter 6.

5.2.7 Future Product Development

Some activities to develop a fully online programme were not possible within the budget of this project, for example, developing a brochure site for potential participant schools. Instead, the homepage was designed to provide information to advertise the programme. Providing a temporary login with access to one session can provide trials for interested parties.

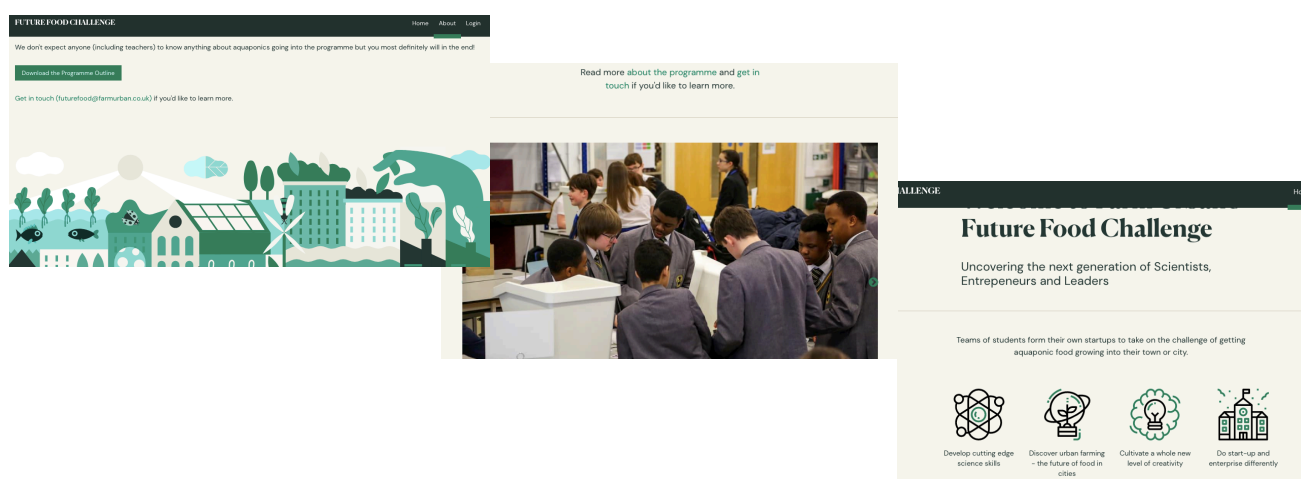


Figure 21 – homepage (more images in appendix)

It was also desired that more onboarding activities such as booking talks could be completed on the platform, but this was not possible within the budget for this project. Whilst originally more content was sought for recruitment and onboarding onto the Future Food Programme, the EcoVerse platform has been utilised to adapt its existing features for this purpose as described.

The design of the Future Food Programme content has aimed to make the project inclusive for different learning styles, and was successfully adapted by a teacher for use in a school educating students with special educational needs. Having learnt from the experiences of these participants, the importance of developing ways of communicating the programme concepts was evident. As such, EcoVerse is developing content specifically for students with special educational needs, which will use Augmentative and Alternative Communication symbols, and adapt activities further for a wider variety of learning styles and educational outcomes. It is also important that future development of the platform incorporates more accessibility features.

With further investment in the EcoVerse platform, more features will also be developed to reduce in-person support from Farm Urban staff, and make the session content more interactive for students. This could include the gamification of some content and the use of further technology of relevance to the field of aquaponic technology, for example, sensors for monitoring water chemistry. Such features could enhance collaboration between programmes hosted on the EcoVerse platform, where

there is cross-over between subjects, and provide ongoing or new opportunities for collaboration between students and scientific industries developing low carbon solutions.

Finally, impact assessment is integral for ensuring that the EcoVerse platform and the content is accomplishing its aims for all stakeholders and can be developed and refined to ensure best practice. Initially an independent evaluation of the pilot Future Food Challenge was completed to assess the strengths of the programme and areas for development. Subsequently, this research project was conducted to develop a platform upon which the Future Food Challenge and other education programmes for low carbon technologies could sit. The data collected for both the evaluation and this thesis has relied on paper-based feedback, and in person interviews and focus groups. The platform, with consent from students, allows for impact to be measured through the skill and knowledge progress tools. However, future iterations of the EcoVerse platform must provide further impact and assessment measures.

5.3 Conclusion

Farm Urban was created to address health deprivation by reconnecting the local community with sustainably grown food. Their approach developed in three complementary directions: food growing, research and education. Farm Urban wish to establish themselves within Liverpool as they innovate food growing methods as part of a developing green sector, however the organisation has identified that this requires public education and engagement.

Farm Urban's first educational programme was the Future Food Challenge, which sought to educate students about sustainable food growing. The merit of demonstrating the journey of Farm Urban as a start up social enterprise quickly became evident. At the beginning of the chapter, it was considered, as raised by North, that a low carbon economy was being considered without a change of perception about local economic development. To establish a low carbon future, young people need to be equipped not just with knowledge of low carbon technologies and how to innovate them, but about how to aid their community in overcoming barriers resulting from regional deprivation. Whilst a state response and attention to socioeconomic factors in Liverpool is required to lift parts of its population out of poverty, students must be not only aware of the factors which contribute to deprivation, but be empowered to demand sustainable solutions to health, economic and employment inequality.

EcoVerse was born out of the Future Food Challenge, as the potential of how the programme was structured was recognised, and it was envisioned that the platform could host further educational content relating to other low carbon technologies. Through hosting the Future Food Challenge as its first programme, EcoVerse has recognised the value of industrial-educational partnership. Such a partnership has been successful for the schools that have participated. Curriculum topics are brought to life through the Future Food Challenge as the science behind anthropogenic climate change is juxtaposed with the science behind sustainable solutions.

The Future Food Challenge has developed an holistic approach to not only explore what is being done to develop sustainable food growing technologies, but also how

and why. The programme challenges traditional boundaries, as teachers and students learn together, and young people and experts innovate together. Students learn the scientific rationale behind the projects that they are developing and implement their ideas whilst enhancing their digital literacy through the use of business tech tools such as Asana for project management or Slack for communication, as well as Farm Urban's digital resources. Using technology in this way helps students and teachers to use EdTech in a way that does not feel contrived, therefore demonstrating the utility of EdTech as a useful pedagogical method, rather than a gimmick.

As students utilise and learn from the Produce Pods and design and build their own prototype aquaponics system, their peers are able to see an ecosystem at work in the spaces within which they are being educated. Through this process, environmental education is reimagined as students are empowered to see their own creativity harnessed for future food solutions. As EcoVerse expands its reach to home programmes for adult learners, learners with additional needs, intergenerational groups and marginalised communities, this EdTech tool can be used to promote inclusive local and sustainable economic development by up-skilling potential employees in this field.

This chapter has demonstrated the research and development that was undertaken to develop EcoVerse's online platform, and a successful output of the research has been an operational EdTech tool, the EcoVerse platform, which is ready to be used as a vehicle for the delivery of Farm Urban's Future Food Challenge. This EdTech tool will be used with the Merseyside schools currently participating in the Future Food Challenge. The utility of the tool has further increased with the need for new pedagogy resulting from the COVID-19 pandemic, which has determined that each school will have to deliver the programme in a different way to previous years, and in many cases online. The first desired outcome was for the research to understand user requirements to enable a digital solution, the progress of which has been outlined in this chapter. As discussed, a useful by-product of the research was the production of additional resources which can be used by students and teachers taking part in the Future Food Challenge, and have been included in the appendix for reference. The following chapters will use the data gathered to continue to build a methodological framework for the content to be transferable to alternative audiences.

5.4 References

Batty, R., Sharples, M., Florescu, A., Wong, A., (2019) ‘EdTech testbeds: models for improving evidence’, *Nesta*, available at: <https://www.nesta.org.uk/report/edtech-testbeds/>, accessed on 3 September 2020.

Department of business, energy and industrial strategy, (2019), ‘Green collar jobs in offshore wind set to triple by 2030’, available at: <https://www.gov.uk/government/news/green-collar-jobs-in-offshore-wind-set-to-triple-by-2030>, accessed on 3 September 2020.

Liverpool City Council (2019), ‘Indices of deprivation’, available at: <https://liverpool.gov.uk/council/key-statistics-and-data/indices-of-deprivation/>, accessed on 15 August 2020.

Liverpool City Region Local Enterprise Partnership (2020), available at: <https://www.liverpoollep.org/growth-sectors/low-carbon/>, accessed 15 August 2020.

Liverpool City Region Brussels Office, (2017), available at: <https://www.liverpoollep.org/wp-content/uploads/2015/06/Building-Climate-Resilience-in-Liverpool-City-Region-FINAL2017.pdf>, accessed on 15 August 2020.

North, P., (2010), ‘Unsustainable urbanism? Cities, climate change and resource depletion: a Liverpool case study’, *Geography Compass*, 4(9), pp. 1377 – 1391.

Skillsbuilder Partnership (2020), available at: <https://www.skillsbuilder.org/>, accessed on 4 September 2020.

Taylor, I., and Widdas, E., (2018), ‘Expanding the Farm Urban Initiative: evaluation report no. 1’, made available by Farm Urban for the purposes of this research, pp. 1 – 14

Taylor, I., and Widdas, E., (2018), ‘Farm Urban Future Food Challenge: Evaluation report no. 5’ made available by Farm Urban for the purposes of this research, pp. 1 – 54.

Taylor, I., and Widdas, E., (2018), ‘Farm Urban Future Food Challenge: Evaluation report no. 6’ made available by Farm Urban for the purposes of this research, pp. 1 – 42.

Taylor, I., and Widdas, E., (2018), ‘Farm Urban Future Food Challenge: Evaluation report no. 7’ made available by Farm Urban for the purposes of this research, pp. 1 – 54

Taylor, I., and Widdas, E., (2018), ‘The Future Food Challenge: Teacher’s welcome day evaluation report’ made available by Farm Urban for the purposes of this research, pp. 1 – 33

Taylor, I., and Widdas, E., (2018), 'The Future Food Challenge: Launch Day participant perceptions', made available by Farm Urban for the purposes of this research, pp. 1 – 43.

6. Research Cycle 3 – Results

6.1 TEDx talk feedback

Using the TEDx talk feedback forms, data analysis was performed using NVivo and Microsoft Excel. As discussed in the methodology chapter, NVivo was used to perform line by line qualitative coding on each of the answers in the feedback forms, and a thematic analysis was completed to establish nodes (categories) into which the responses could be organised. The feedback forms contained open boxes for students to write their thoughts, and therefore some students expressed ideas that fell into two different categories. In these instances, their statements were coded at more than one node. The data analysis therefore considers the number of references concerning each of the categories, rather than the number of participants who chose a specific category.

6.1.1 Question 1: What did you take away as the most important message from the talk today?

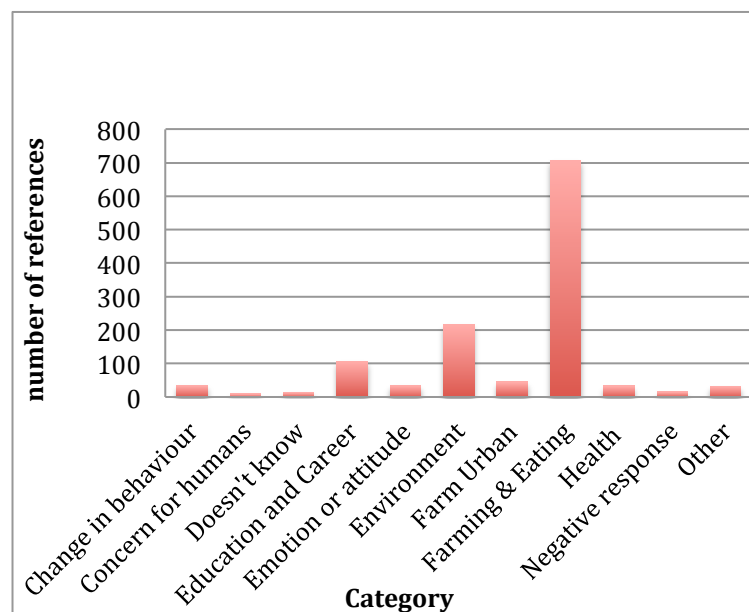


Chart 1- question 1 references

As discussed, the main themes throughout Farm Urban's talks are; career; health and wellbeing; food production; sustainable farming and behaviour change. It is evident that students have taken away each message in significantly differing numbers. Farming and eating, which includes both food production and sustainable farming methods, is clearly the most referenced topic in student feedback for question one. To further understand the student feedback, we will focus on the two categories referenced significantly more often than the rest: Environment and Farming and Eating.

Environment was dimensionalised into three categories: Individual reflection about the environment, immediate collective action for the environment and individual

specific action for the environment. These subcategories were designed to reflect what students thought and felt about the topics that they had heard in relation to the environment compared to what actions they could identify as a response to the environment. Actions were further broken down into ‘individual’ or ‘immediate collective’, to use context and pronouns to interpret whether students are identifying an action that they could take alone, or whether it would be a more general action for a sphere within which they move. The use of context and pronouns was also considered to be a way to establish how students were assigning responsibility through their reflections and suggested actions. For example, should a student consider ‘environment’ to be the most important message from the talk they may suggest an action such as ‘I will reduce the use of plastic I use’, suggesting that the student feels a personal responsibility to respond to environmental issues. The student may alternatively say ‘we need to take action’ which could mean ‘my family and I’, ‘my school and I’, or broader still collectives. However the use of ‘we’ still suggests the involvement of the participant.

References categorised as reflections suggest a specific fact or consideration taken away from the message. This can include distant collective action, such as ‘people need to take care more’, of which the pronoun would be ‘they’. As ‘they’ is a pronoun regularly associated with figures of authority, for example: “they need to fix the roads” or “they’ve put up the parking prices”, this could indicate a student’s belief in authoritative mechanisms whose actions dictate the future of environmental health. This view of climate issues could understandably limit the student’s own want or need to undertake personal environmental action, should they consider their actions to have a negligible effect on solving the climate crisis.

Despite ‘individual reflections about the environment’ being a broad term, the level of specificity of the answers could only be broken down slightly further, to consider reflections specifically about animals or plants. The majority of responses reflected on the existing damage to the environment and the need for intervention, with 66% of participants using variants of the phrase “the environment is damaged”. Table 1 lists in vivo examples of statements under the subcategories.

Code: Environment	In vivo responses to “What did you take away as the most important message from the talk today?”
Individual reflections about the environment 66% of references within ‘environment’ code	“The world needs to change” “The world is dying” “Something needs to be done quickly” “People need to change the environment they live in”
Immediate collective action for the environment 29% of references within ‘environment’ code	“We need to help the environment” “As a community we need to work together to save the world” “We need to take action to stop the planet from dying”
Individual specific action for the environment	“To start not buying any plastic packaging” “I feel as though I can change my lifestyle to

5% of references within 'environment' code	benefit myself and the environment" "I will take away that I need to take more interest in the planet and look after it more"
--	---

Table 5

The majority of the references coded as 'environment' are generalised reflections about the environment and consideration of distant collective action. The TEDx talk is roughly 16 minutes, 31 seconds long, however there can be slight deviation as the talk is delivered in person. The speaker spends the same amount of time on each topic, as the talk has to keep time with animated graphics which operate to a set time. The talk covers global environmental issues relating to food production for a total of 5 minutes and 55 seconds. This third of the talk clearly included the messages that students received the most as 75% of the references for question one relate to the environment and food production. However, when students identified that our current farming methods are not sustainable for a growing population, amidst other environmental challenges associated with farming, the specificity of the information provided and number of proposed solutions increased compared with references coded as 'environment'.

Code: Food Production and Consumption	In vivo responses to "What did you take away as the most important message from the talk today?"
Individual reflection about sustainable food production 61% of references within 'food production and consumption' code	"That in 2050 when we are older and have family we need 70% more food" "That the fish feed the plants and it goes through a cycle." "That food should be processed in a better environmental way"
Immediate collective action for food production 35% of references within 'food production and consumption' code	"We can grow plants in a different way" "We need to reduce food waste and improve our ways of food production" "How badly our food is currently made and that we have to improve this and the urban farm project is a step in the right direction" "We need to improve farming and the way we eat"
Individual specific action concerning sustainable food production 4% of references within 'food production and consumption' code	"To tell other people about the process and how we can help" "I need to know what I'm eating as it affects me" "Grow more plants" "recycle more"

Table 6

Compared to references coded as 'environment', there is a wider range in reflections coded as 'food production and consumption'. There is also a slight increase in identified action responses, from 34% for 'environment' to 39% for 'food production and consumption'. The increased specificity in reflection and slight increase in considered actions suggests that for these participants, they have understood not only

that the environment has been damaged in many different ways by human activity, but also that many aspects of environmental destruction relate directly to food production and consumption, activities which, in the UK, we are all unavoidably a part of. However, regarding sustainable food production, there were fewer references to individual action. This is understandable, as students may feel that the food industry is too big an entity to address without immediate collective action. Although, where specific actions were identified, they ranged from raising awareness about the unsustainability of the food system, to changing our consumer habits, or ultimately growing our own food. The solutions suggested by students are summarised below:

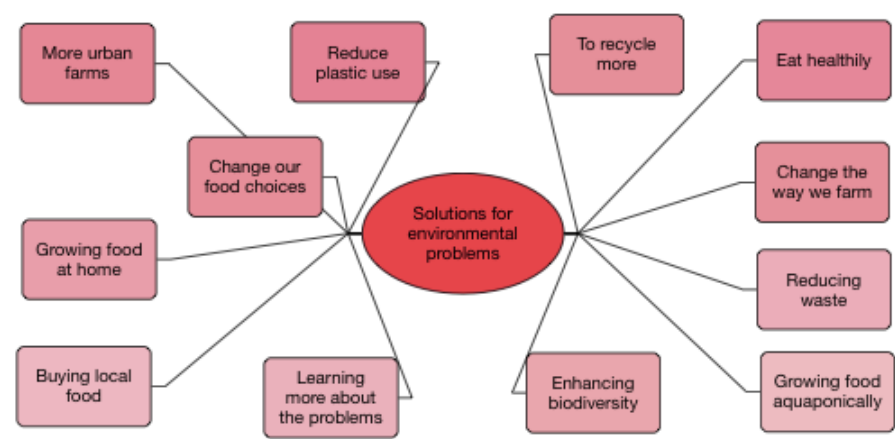


Figure 22 – student solutions for environmental problems

The solutions incorporate how we grow food, consumption habits, learning and managing manufactured waste. However only two of the solutions, the way we grow food and enhancing biodiversity, suggest enhanced engagement with the natural world.

6.1.2 Q2: In what way does this message inspire you personally when you think about your future?

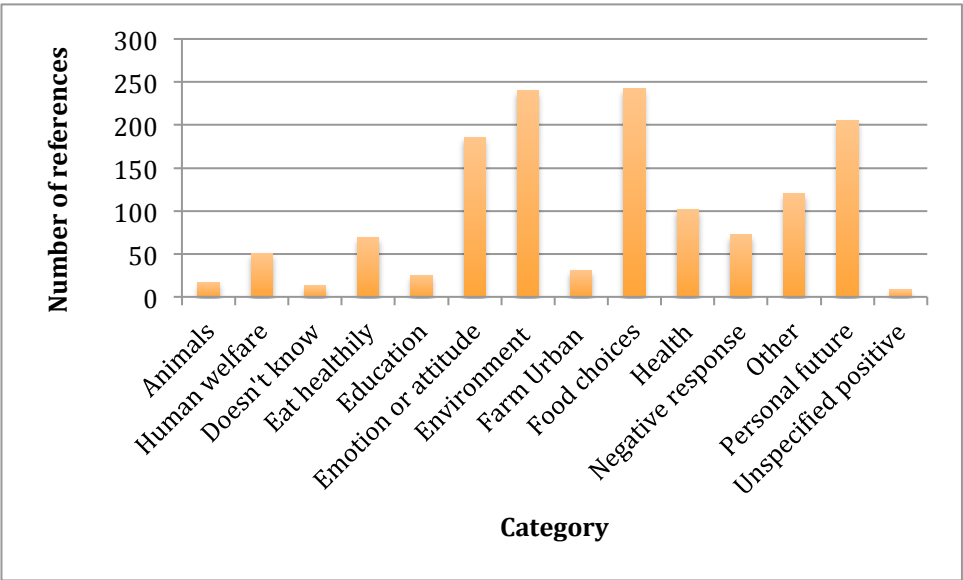


Chart 2 – question 2 references

Following the TEDx talk, when students reflected on what, if any, personal inspiration they took from the topics about their future, both environment and food choices proved to be the most referenced categories again. Additionally, however, students also discussed their emotional response more openly as well as thinking about their future more specifically in terms of their education and career.

Code: Food choices	In vivo responses to “In what way does this message inspire you personally when you think about your future?”
Individual reflection concerning food choices 49% of references within ‘food choices’ code	“That we need to change how food is processed” “Not trust where food comes from” “It inspires me to think about what I eat and how long it has taken to get to the shops” “I think that more people should invest in improving it so that our future is brighter”
Individual action about food sustainability 37% of references within ‘food choices’ code	“To question where my food comes from” “To grow my own food” “Have aquaponics in my own house” “Make sure all food that I buy is organic and from local sources” “It inspires me to learn more about renewable and safe ways to produce food”
Individual action about what food to eat 14% of references within ‘food choices’ code	“Change diet” “Helped me think about eating cleaner” “Be a vegan” “Eat less fatty meats” “To drink super juices”

Table 7

Compared to question 1, responses about food production and consumption regarding inspiration about the future, elicited far more individual action responses. This can be expected as the question asked specifically about personal inspiration. Interestingly, whilst ‘inspiration’ is usually associated with creativity, specifically idea generation, several students felt ‘inspired’ to be more cynical or at least questioning of the information that they are told, for example ‘not trust where food comes from’. Students could also come to different conclusions about the same topics, for instance, whilst one student seems to suggest that they might consider being a vegan, another student felt satisfied to ‘eat less fatty meats’. Naturally, such responses to the information highlighted through the TEDx talk will fit within narratives already present in the students’ perceptions of the world, including familial, cultural or other factors that have been influential on their set of beliefs.

For question 2, the second most referenced category was, again, the environment:

Code: Environment	In vivo responses to “In what way does this message inspire you personally when you think about your future?”
Individual reflection concerning the environment	“That the future will be ruined if we don't help”

43% of references within 'environment' code	"The world can be a better place" "Makes me think how close we are from crisis" "Something needs to change in order for us to prosper as a species and live sustainably"
Individual action concerning the environment 57% of references within 'environment' code	"It makes me want to do more for the environment so we can eat in the future" "This inspires me to research in the future to benefit the development of aquaponics" "Want to make sure that there are more fish when we are older" "Put things in a bin"

Table 8

For question 2, the considerations of actions that could be taken significantly outnumbered reflections about the environment. However, the content of the responses were similar to answers about the environment outlined in question 1.

In response to question 2, students often referenced their emotional response to the information received, or articulated a change in attitude.

Code: Emotion or attitude	In vivo responses to "In what way does this message inspire you personally when you think about your future?"
Gratitude 6% of references within 'emotion or attitude' code	"It inspired me to be grateful that we were informed about it" "To appreciate the environment"
Hard work 14% of references within 'emotion or attitude' code	"It inspires me to work hard" "To try my best"
Limitless possibilities 11% of references within 'emotion or attitude' code	"I can do anything and there are loads of possibilities" "That you can change the world"
Negativity about future 3% of references within 'emotion or attitude' code	"It means that my job probably isn't around yet presents uncertainty" "Think about the future and how it looks bleak"
Personal responsibility for action 20% of references within 'emotion or attitude' code	"I could be involved in this change. I could make a difference to the health of the environment" "That I can help solve the problems"
Positivity about the future 9% of references within 'emotion or attitude' code	"It gives me hope for the next generation" "It has calmed me down and I'm no longer stressed about my future I understand that I don't have to worry about it"

Reflection on the information conveyed 9% of references within 'emotion or attitude' code	"To think about all the positives and negatives" "This inspires me in a good way makes me think about all of the different things that could happen in the future"
Resilience 3% of references within 'emotion or attitude' code	"To step out of my comfort zone" "It inspires me to want to stick to what I enjoy and carry on doing it and not give up"
Step by step approach 1% of references within 'emotion or attitude' code	"That little things can make a big difference" "Things need to be done step by step not all at once"
The need for change 17% of references within 'emotion or attitude' code	"For me, it only really makes me want to reform capitalism from within and that these systems cannot change our food system" "It shows change is possible but we need to change"
The power of an individual 7% of references within 'emotion or attitude' code	"That anyone can help change this" "That you can make a difference"

Table 9

Although a wide range of emotions are considered within this question, it is significant that only 3% of emotional responses express negativity about the future. This is surprising, as the talk not only highlights the destruction of the environment that has already taken place, but also raises the concern that within the next thirty years, without significant change to food production practices, it will be impossible to produce enough food to sustain a growing population. Rather than expressing feelings of existential dread, the students are instead describing emotional responses such as realising their own potential to promote positive change, to actively want to make a difference, or even to express gratitude that they were informed about the situation.

It was discussed in respect of coding at 'food choices' that some students were 'inspired' to feel cynical about the practices of the food industry. Furthermore, gratitude for knowledge about the realities of challenges faced by the planet suggests that some students recognise that it is only through transparent information that true change can be enacted. Additionally, it could be said that many young people have an idealistic approach to problem solving than those with more life experience. As the Future Food Challenge seeks to empower young people to innovate future food solutions presently, not in their future, it is important to reflect that young people can be sources of unbridled enthusiasm, a key aspect of innovation, and therefore should not be excluded from problem solving environmental issues.

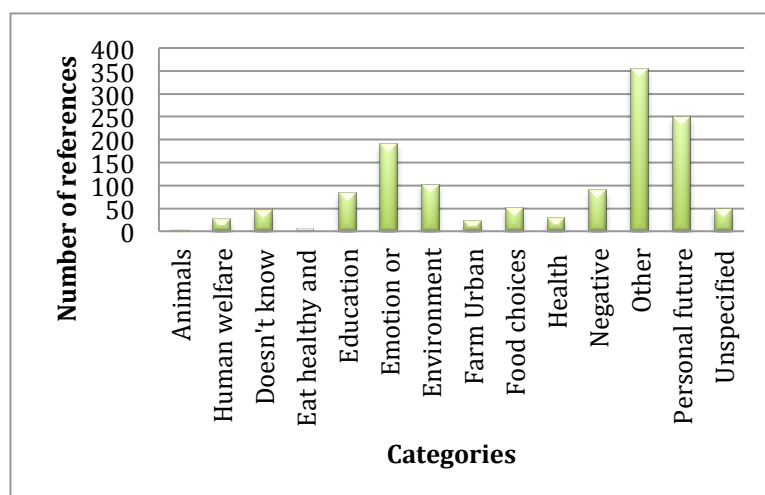
Code: Personal future	In vivo responses to "In what way does this message inspire you personally when you think about your future?"
Individual reflection regarding personal future	"It made me think about why I really want to do the job I want to do."

75% of responses within 'personal future' code	<p>"It gives me techniques for the future and insight to how you can use your work efficiently and something you enjoy should matter as long as you enjoy it."</p> <p>"That this is a possible job and I could work in"</p> <p>"I want to have a career in science so seeing that it can do good to help people and the planet is really powerful."</p> <p>"Farm Urban has opened my eyes to a career path I didn't previously think of."</p>
<p>Individual specific action regarding personal future</p> <p>25% of responses within 'personal future' code</p>	<p>"That I need to help change/help the earth with my career"</p> <p>"To start a company"</p> <p>"To think of my own discovery in the future"</p> <p>"To help make a better future by using my skills to help"</p> <p>"In the future I hope to run my own company that reduces the carbon footprint in boats so this has helped me realise how to start that"</p> <p>"To try new things/ways of doing things"</p>

Table 10

The third most referenced code for question 2 was 'personal future', which was anticipated as the question specifically asks students to consider this. Reflections largely focussed on potential future careers, rather than any other aspects of the future such as where they might live or their future relationships. This may be due to participants' age, as the participants who are 14-15 are being called to think more about potential careers as they make subject choices for their GCSEs. However, many responses, in particular specific action responses, consider their future careers in the context of themes covered within the talk. For example, some students have considered that they may 'help make a better future by using my skills to help'. For future data collection, it would be interesting to gather responses before the talk takes place to identify how many participants consider the environment when thinking about their future careers compared to after the talk.

6.1.3. Q3: How has today helped you to think about your future goals and the steps you plan to take to achieve them?



For the final question asking for a qualitative response on the feedback form, students were asked to think specifically about their own future goals. As the feedback forms were filled out directly after the TEDx talks were delivered, it would be expected that many students would answer with reference to their future goals within the context of environmental concerns, more so than if they had been asked to reflect upon their future before hearing the talk. Although answers referencing the environment or food choices had far fewer references than for the previous two questions, within the second most highly referenced category, ‘personal future’ there was much consideration of participants’ futures in the context of the environment. For example, “it’s made me consider if my future job will be helpful for the planet”.

However, the most referenced category was ‘other’:

Code: Other	In vivo responses to “How has today helped you to think about your future goals and the steps you plan to take to achieve them?”
Blank (92% of references within ‘other’ code)	
Illegible 5% of references within ‘other’ code	
Miscellaneous 3% of references within ‘other’ code	“Bezos is bald and I also will become bald” “I want trim like funk ops”

Table 11

For the first time throughout the qualitative questions, the most referenced code was ‘other’. Of references coded as ‘other’, 92% of references were to answer boxes which were left blank. Students may have not answered this question for several reasons:

- They did not know what their future goals were at this point.
- They did not know how ‘today’, that is to say the talk, had helped them to think about the future.
- As this was the last question on the feedback form, they ran out of time to answer the question before the assembly had finished.

Additionally, it is not clear whether students potentially struggled to answer what their personal goals were, or what steps they planned to take to achieve them. For this reason this question would perhaps benefit from being split into two separate questions in the future. It also could be said that students who had reflected on their personal future in the previous question may have felt that they had already provided an answer to this question.

For the purposes of delivering the TEDx talk and obtaining feedback, improvements could be made in rewording the questions asked regarding students’ views of their future. However, it could also be said that the students may benefit from hearing

within the talk more suggestions as to specific actions that they could take in the future to prompt them to think about their next steps, and provide a framework for action for students who are interested in becoming more active in solving environmental issues.

Code: Personal future	In vivo responses to “How has today helped you to think about your future goals and the steps you plan to take to achieve them?”
Individual reflection concerning personal future 88% of references within ‘personal future’ code	“Take risks” “It’s made me consider if my future job will be helpful for the planet” “That its okay not to know what to do in life and you can explore” “It’s helped me think more about my future as I want to achieve good goals and I think Farm Urban has helped me think positively”
Individual specific action concerning personal future 11% of references within ‘personal future’ code	“I feel like it can teach people in the future about the problems in manufacturing and inspire them to make a change” “I want to be a vet and it has helped me think about why. I would really like to take part in the sessions” “I want to be a marine biologist so it inspired me to work for my dreams more to help” “It has inspired me to start my own business in the future”
Had already planned goals 1% of references within ‘personal future’ code	“Nothing I’m still going to be an engineer” “I already knew what I am going to do” “I want to be a dancer”

Table 12

The second most referenced category for question 3 was ‘personal future’. Similarly to question 2, most students when thinking about their future thought in terms of their future careers. Students responded very differently to this question. Whilst some felt reassured by the message, feeling that they did not presently need to worry about their future or know what their plans were, other students felt that the message of the talk was that they should start to think about their future plans now.

Some students interpreted connections between careers that they had previously considered and the messages from the talk, for example one student who wanted to be a vet felt that following the talk she should reflect upon the reason why she wanted to pursue this career. Another student who wanted to be a marine biologist identified that the talk had encouraged him, as his career could help the environment. However, other students did not see the potential relevance of their planned careers. One student felt that the talk had not helped because he wanted to be an engineer, despite the potential relevance of this discipline to environmental issues. Another student more understandably did not see the relevance of the talk to her desired career as a dancer.

Code: Emotion or attitude	In vivo responses to “How has today helped you to think about your future goals and the steps you plan to take to achieve them?”
Confidence 13% of references within ‘emotion or attitude’ code	“It has made me feel more confident in what I must do in the future to achieve my goals” “It tells me "I can"”
Gratitude 0.5% of references within ‘emotion or attitude’ code	“That I will be more happy for what we have to protect the environment and wildlife”
Limitless possibilities 12% of references within ‘emotion or attitude’ code	“Helped me to understand that I can do anything” “I should think more broad”
Negativity about future 0.5% of references within ‘emotion or attitude’ code	“It makes me feel scared for the environment”
Personal responsibility for action 12% of references within ‘emotion or attitude’ code	“It has helped me understand on how my choices always have an impact” “It has helped a lot because we will be in charge one day so we need to help now”
Positivity about future 7% of references within ‘emotion or attitude’ code	“It made me feel a lot better about it” “It makes me want to achieve my goals and I feel that is possible”
Power of an individual 3% of references within ‘emotion or attitude’ code	“It made me realise that anyone can make a big difference to the planet” “It has just gave me more of an insight to what great people have done and that I can do the same”
Reflection about topics conveyed 7% of references within ‘emotion or attitude’ code	“It has helped me see the bigger picture” “Its made me think about a different lifestyle.”
Resilience 6% of references within ‘emotion or attitude’ code	“To have good resilience to save the world” “It made me think that we need to change things in our lifestyles so it is showing that your shouldn't give up”
Seeking or displaying an attribute 7% of references within ‘emotion or attitude’ code	“Be motivated and eager” “That I need to take a chance and be honest no matter what”

Self belief 3% of references within ‘emotion or attitude’ code	“I feel I am strong and smart enough to achieve something like the presenter has achieved” “Believe in yourself”
Step by step approach 3% of references within ‘emotion or attitude’ code	“I should attempt to achieve my goals one step at a time” “It helped me see the bigger picture and how to create something from almost nothing”
The need for change 5% of references within ‘emotion or attitude’ code	“It has helped me realise what I need to change” “It gave me an idea of how you can change the future”
Work hard 21% of references within ‘emotion or attitude’ code	“Work hard to achieve” “He tells me I need to push myself and other people for real change.”

Table 13

Question 3 also prompted an emotional response from a significant number of participants. Most students (21%) felt that the talk had helped them to think about their future goals and plan their next steps by encouraging them to work hard. The other most referenced categories included ‘personal responsibility for action’, ‘limitless possibilities’ and ‘confidence’. Students describing their emotional responses seemed to understand from the talk that the speaker had identified an environmental problem and both recognised a potential solution and set up a social enterprise to attempt to solve it. This message potentially resonated with students further because the speaker, Dr Paul Myers, was from Liverpool himself, and therefore students might have felt capable of achieving their goals as someone from the same city had.

Again, an extremely low number of references denoted a significant negative attitude towards the future (0.5%). Rather, students identified that there must be behavioural and systemic change to enact a sustainable future, but felt empowered to be a part of that change. The literature review for this research identified a growing number of students demanding that the teaching of environmental education should become a priority in their schools. This data suggests that students do largely respond positively to information regarding the environment. The literature review also considered that there is a strong possibility of students developing ‘eco-anxiety’ which must be supported and managed. It could be interpreted that the largely positive emotional response from students regarding the TEDx talk was due to simultaneously receiving knowledge about environmental issues, and a solution that was achievable at a local level.

6.1.4 Likert scales

To accompany the questions asking for qualitative responses, the feedback forms also included Likert scales, which asked the following questions:

- 1) I feel inspired to find solutions to the 'big' problems that I care about
- 2) I'm interested in learning new information and skills
- 3) I feel more confident about what I might do in the future
- 4) I have a better understanding of how studying at university could help me to achieve my goals

Students were asked to select a value from 1 to 6 correlating to how much they agreed with a statement. The results are displayed below.

	Q1	Q2	Q3	Q4
Strongly agree	329	351	215	318
Agree	616	586	435	521
Neither agree nor disagree	190	171	388	245
Disagree	14	38	85	43
Strongly disagree	39	34	60	55
Blank	16	24	21	22

Table 14

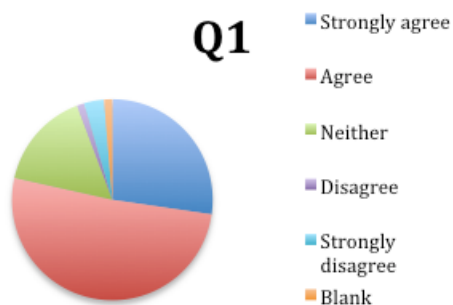


Chart 4

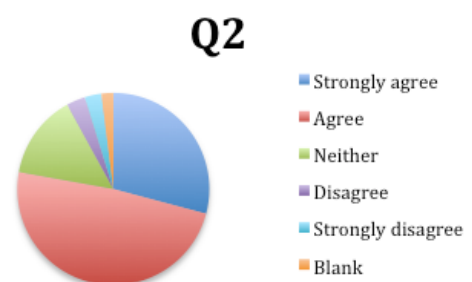


Chart 5

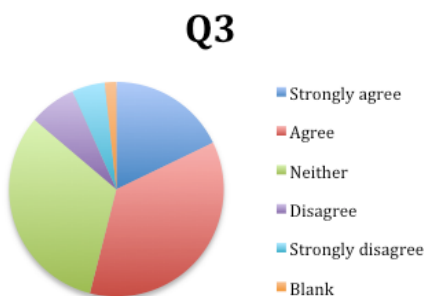


Chart 6

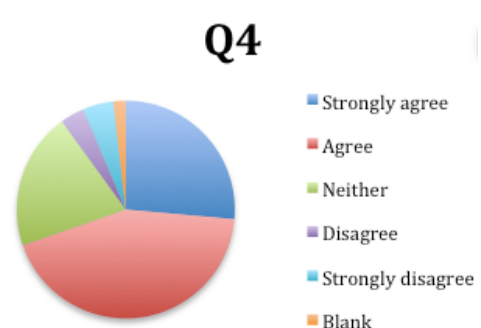


Chart 7

For all questions, over half of all students answered that they either agreed or strongly agreed with the statements. The first Likert scale, which asked students if they felt inspired to find solutions to 'big' problems, received the largest overall agreement (78%). Based on the context in which the questions are being asked, the fact that most

students had answered earlier that they took away messages about the environment, food production and consumption as the most important issues, and explained the reasons behind why the talk had personally inspired them, one could assume that a significant amount of the students are defining ‘big problems’ in environmental terms. Again, it would be interesting to ask students to complete the Likert scales before and after the TEDx talk was delivered to see if there are significant changes in the answers given.

The largest number of participants ‘strongly agreed’ when asked if they were interested in learning new information and skills (29%). There was evidence in the qualitative data that students were ‘grateful’ that they had been given the information that was outlined in the TEDx talk. This reiterates the findings of the literature review that concerning environmental education, many students are interested, engaged with the issue and wish to learn more. The literature review highlighted that employers found that many students were unable to articulate the skills that were required for employment. It would therefore be interesting to gain further insight into students’ own perceptions of their knowledge and skills according to the known, unknown paradigm.

Known-knowns Knowledge – the information or skills that students know they have	Known-unknowns Students’ awareness of the knowledge that they do not yet have themselves
Unknown-knowns Knowledge or skills that students possess without realising	Unknown-unknowns Knowledge or skills that students do not know that they could have access to

Table 15

When students were asked whether they felt confident about what they might do in the future, the statement received the least agreement of all of the Likert scales (54%). This correlates to the qualitative answers that students gave for the question ‘How has today helped you to think about your future goals and the steps you plan to take to achieve them’, for which the majority of students did not provide an answer. This is reasonable, as the participants for this data, having not chosen their GCSEs yet, are only entering a period during which they are asked to make decisions about their future.

As discussed, when asked about their personal futures, the majority of students articulate their thoughts in terms of, most commonly, their career, if not their continuing education. It could be argued that this is indicative of the emphasis that the education system often places on passing exams in order to progress to higher education or a ‘good’ career. In response to the talk, some students commented that it helped them to plan their future goals by helping them to ‘see the bigger picture’, or to think more broadly and many students did identify specific actions they could take to help the environment. The literature review also considered that our understanding of our ‘needs’ as humans have become intrinsically linked with our use of carbon. Education for sustainable development must engage an individual’s perception of the world. The data suggests that students’ focal point is largely on their education and career, and whilst this is important, it could be beneficial for both the student and the environment to ensure that the future is also considered in terms of engagement with the natural world.

The majority of student answers to question 4 indicated that they understood that attending university could help them to achieve their goals. Interestingly, university is spoken about in the TEDx talk for little over one minute. The reason for students being largely in agreement with this statement could either be because they had preconceived ideas about university, and many felt that it would be a positive decision in relation to their future. It could also be considered that the agreement is related to *how* university was discussed, albeit for a short time, during the TEDx talk. The talk, written by Dr Paul Myers, begins with his experience of school, interest in science and hopes for the future. After changing his mind about his future career, Paul goes on to discuss what he found out through his higher education, including his PhD. His understanding of the world through his higher education resulted in his decision to respond by designing and building an aquaponics system and subsequently establishing a hydroponic farm. Whilst his education is mentioned fleetingly, it can certainly be identified as the starting point of his journey. Particularly when exhibiting an emotional response, many students commented that they had been inspired by the potential for an individual to make a difference, for example, “It has just gave me more of an insight to what great people have done and that I can do the same”. This perception may have influenced students’ understanding of the utility of higher education. As has been mentioned throughout the data analysis, data gathered before the talk, as well as after, would be useful for making further assessments of this nature.

6.2 Teacher Interviews

Three semi-structured interviews were conducted with teachers who had previously delivered the Future Food Challenge. It was not possible to conduct further interviews, as there was a low response rate. This could have been due to the interviews being conducted after schools were closed due to the pandemic, and many teachers had additional pressures on their time, as they organised online classes. The three interviews conducted contain interesting information about student and teacher responses to environmental education, the delivery of the Future Food Challenge, and the use of technology in schools. Therefore, despite the small number of interviews, they are worth discussion.

6.2.1 Environmental education

The literature review discussed the provision of environmental education in UK secondary schools, however all of the interviews were conducted with teachers who work within the Merseyside region. As discussed earlier, there are many aspects to environmental education, from the content taught in lessons to the buildings within which students are taught. Topics concerning environmental education were discussed with the teachers:

Topic	Participant responses
Teacher attitudes towards the environment	Participant 1: “Yeah, I didn’t think [that the Future Food Challenge would affect views on environment] to be honest, but yeah absolutely in a really good way. Erm, definitely I think a lot more about sustainability, about food miles, I think is a big thing as well. I think that, and recycling, and making sure that you’re putting a positive image over to the pupils and like, making sure that you’re modelling what we’re expecting pupils

	<p>to do”</p> <p>Participant 2: “you think, you try and do your own little bits at home, we’re pretty okay with recycling, stuff like that, we’re not brilliant by any means but we do a bit. So you think that when you do something like buying local fish for instance would be helping, but then not necessarily at all, so [the TEDx talk] just was a big eye opener really to all those sort of things.”</p> <p>Participant 3: “I think that it’s unavoidable to know what your impact is to the environment now, and whether you choose to act on it or do something about it is very much up to you.”</p>
The curriculum and Keystage 3-4 learning	<p>Participant 1: “I personally have been putting a huge amount more focus on sustainability and the environment any opportunity we can really, so one of the lessons we write lessons to Boris Johnson, another lesson we’re doing, like, erm, strike for schools climate change where they make their own banners as like an education tool, and with lockdown, quite a few of our lessons are based on like COVID you know, pollution has gone down by like 27% so getting pupils to look at data and see. We get students to look and think like how we could make really small steps to have a big impact and change over time. Because we said, you know, obviously it’s not sustainable, and the fact that you can’t just keep pollution down, but it’s you know, because everyone stopped. But it’s helping the pupils to see different ways in which we can continue to reduce it really and I think the Farm Urban, the project helped me a huge amount with that”</p> <p>“I think since we’ve been rewriting our programmes of learning for key stages 3 and 4, just on a personal level, I’ve definitely tried to introduce it more, like in our opening slides for careers, or how it links to you, so I think like for me individually, it’s definitely become a much more important part of the lessons... I’ve been doing ‘using resources’, so a friend who’s doing structure and bonding might find it a little bit more difficult to make as many links”</p> <p>“We have like a science capital slide, so that might be, and everyone will have to do that in their schemes, so that will be like a local business, it’ll be a career that they might do, or it will be something interesting in the news. Then we’ll have new information, so anything that’s new and relevant for the scheme, and then we’ll do like, suggested teaching activities, so that’s what we do.”</p> <p>“I still think that how the GCSE is written, the questions that the pupils have to answer is very like scientific factual, erm, it’ll be based on data, or it will be based on - pupils will have to know what causes global warming and how climate change occurs rather than like human impact, influence, stuff like that really.”</p> <p>Participant 2: “There’s some climate change elements in the chemistry, it’s global warming, and erm, what else, I haven’t taught chemistry for a long time. Erm, I think maybe they mention the ozone layer but I think it’s all that stuff that we were doing from a long time ago really. There’s an ecology chapter in GCSE biology, and they talk about biofuels and things like that. But even then, it’s not, I don’t find it hugely relating to us and our everyday functioning.”</p> <p>“It’s sort of these things can be done elsewhere, and you look at developing countries and you think, not necessarily... an alternative source of fuel for them, brilliant, but it’s not saying ‘do it in your garden’.</p>

	<p>Or you know. I don't think really it relates to their every day functioning as students I don't think they get in and think 'I can do that'."</p> <p>"It is more part of the curriculum now than it has been, but not massively. And I think quite isolated. It may be a topic that you cover, but then you move on to something else. It's not really linking it in to everything, and showing how, actually everything's relative to it, or it can all link in to everything you're talking about in some way. I think it's still quite a separate entity."</p> <p>"Yeah, yeah definitely. I think there's so much scope for bringing [environmental education] into other parts of the curriculum. I mean I only think about it in science, but I'm sure, you know, in the other subjects as well, geography, history, languages like, there's room for it anywhere definitely yeah."</p> <p>Participant 3: "there needs to be a systemic change within curriculum planning... I think that every single topic in school, every single topic in every single lesson, it can be weaved into it in a very subtle way, erm, and I don't think that, I'm very, very sad to say that I don't think that will become legislation or something that's enforced."</p> <p>"In some respects teachers hands are tied by content and curriculum, erm, which are going to be assessed. And of course, GCSEs and A levels are the pinnacle of what you're working towards, but those, your lessons inform all of them, all the way down school. So even when you accept a four year old child at nursery in, you know, September 2020, you're not thinking about erm, July 2036 when they're doing their GCSEs, but subliminally you are, because everything you do will build to that"</p> <p>"The only way to make any meaningful change, would be to include some form of green futures topic in a number of the GCSEs and A Levels"</p>
Enhancing sustainability in schools	<p>Participant 1: "To be honest, I've never heard of [the national framework for sustainability] at all, no. And I don't know if people in our school like senior, would but no, I've never heard of it... I'll look into it, it sounds good!"</p> <p>"I think it would be really good if there was initiative from the government which encouraged us further, and made it like, you know, you said before like the old policy? Because often when school have it as part of an Ofsted it becomes more of a priority, erm so if that was to happen you know schools might take it, not that we don't take it seriously, but might take different action steps towards making it a really big part of our curriculum and have impact. I think currently we get obviously the erm, like, our exam board is AQA so we just get points for what the school will, what the pupils will be examined on, and we develop that ourselves and just try to incorporate as much real life as possible. But I could be ignorant there, there could well be a policy there that I just don't know about."</p> <p>Participant 2: "2010 was when I started teaching, and I've never heard of [the national framework for sustainability], no. I've never seen any sign of it either. Saying that, my daughter's in year one, and she is all over environmental stuff. And, not largely from us, I mean we do talk about it here, as in which bin and all that stuff, but she's got a lot from school, I don't know where she's got that from, if it's a curriculum thing, or a choice from their school, but she's well into it, yeah."</p>

	<p>Participant 3: “I’ve never heard of [the national framework for sustainability] and I’ve just written it down so that I can Google it after this meeting. And I’m not going to say that I’m like, the best person to do with the environment or anything, but I’d like to think that I’m quite well informed, and I never knew that was a thing... So I think that a framework for sustainability is something that would be really great to bring back in, because even if every single school, if there were like twenty things you can do, even if every school only did one of them, we’d be better off.”</p> <p>“I do think that there is a push for sustainability, green schools, to be at the forefront, but until it’s in legislation and it’s a white paper and people have to start doing it, no one will do it because everyone’s got a million other things to do”</p>
Environmental initiatives within schools	<p>Participant 1: “So we’ve got quite a big eco-committee, and they do like audits quite a lot round school and they’re always looking to improve services for the school, and do like campaigns, so if it’s like, Fairtrade Day or, like, they’ll put posters up about reducing plastic use, they sometimes do little assemblies on reducing electricity within school, we’ve got a wind turbine as well in school”</p> <p>“Yeah we’ve got automatic lights that turn off in halls, and once you’re in a classroom if you don’t move they go off. So we’ve got that. Obviously we’ve got the wind turbine, I’m not sure about the water, I’m not sure if that comes from like water butts and I’m not entirely sure. I don’t know whether some of the toilets are flushed using water that we’ve caught but I’m not entirely sure. Erm, we used to have like a beehive, but when the lady who worked in our school retired she moved the beehive to a local area because unfortunately no one took it on, but we used to do that as well.”</p> <p>“Yeah, and we’ve got a farm as well, so I think like that links to the environment obviously because we’re thinking about rubbish. Not always from the environmental point of view, but if the rubbish in damaging the animals, if rubbish gets through to the farm it can kill them. So we do it in a roundabout way like that really. I think, I’m not 100% sure, but I think the eco-committee maybe got a local artist in and they did like plastic collection and they made art from the plastic that had been collected.”</p> <p>Participant 2: “I don’t think as the school runs it does much, I know, I remember questioning a few years ago why we don’t just recycle paper and they said the cost, the cost to recycle it is higher than it is to just bin it, which I found quite shocking. So as we run in that sense, as we function it’s minimal. I don’t think that’s to do with being, we’re a PFI school, and the way the money goes to managing recycling and stuff, erm, I don’t think, I don’t know in the canteen, but I don’t think there’s a huge awareness in terms of how they function around it.”</p> <p>Participant 3: “I suppose my class aren’t a particularly good study group, because I indoctrinate them all the time, I suppose another class in school would have been a really good benchmark for whether they, whether they understood concepts beforehand or not.”</p> <p>“Sometimes I feel like in school I am fighting a losing battle. Erm, with environmental stuff and switching off lights and computers and screens and recycling, and not using the plastic cups at the dispenser anytime anyone wants them”</p>
Student climate strikes	<p>Participant 1: “we don’t have any at all [students that attend the climate</p>

	<p>strikes], not that I'm aware of. It's not something as a school that we've ever promoted or pushed or even like signposted pupils to if we're honest. So that's where during lockdown we've put it in a lesson. I'm not saying that we'd actively encourage pupils to do it, but I think maybe a lot of them don't even know it's something that happens"</p> <p>Participant 2: "Yeah, yeah. Quite a few of our team from last year from the Future Food Challenge, yes they said that they went [to the climate strikes]."</p> <p>Participant 3: "I really, really, strongly feel like it shouldn't be down to children to have to be petitioning and marching, and although I go along to every single one of them, when I look at children there who are not at school who are at a climate change rally, it is so incongruous to me as an educator that these children should be missing education to get their point across."</p>
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Table 16

The three teachers who have been interviewed have different levels of engagement with environmental issues. Whilst participants 1 and 2 feel that they have a basic level of knowledge, but could know more, participant 3 is very involved personally in environmental activism. It appeared from the interview that much of the environmental activity taken by participant 3's school arose out of participant 3's personal commitment, rather than school led initiatives.

Each teacher felt as though there was significant scope to explore environmental issues more within the curriculum. Examinations were discussed in the literature review and participant 1 reiterated that the focus of examinations was not human interaction with the environment but the environmental phenomena itself. Participant 2 also felt that the way that environmental education is taught in schools is 'dry' and removed from the day-to-day lives of students.

The schools have very different experiences of sustainability as a part of school life. Whilst participant 1's school has pro-environmental technology ranging from wind turbines to automatic lights, participant 2's school does not even have the facilities to recycle. All of the teachers interviewed had never heard of the National Framework for Sustainability, but liked the idea of it. This appeared to be due to the common view amongst participants that unless there was a legislative action to incorporate environmental education into schools, or unless Ofsted monitored sustainability, it would not be a priority for schools. The literature review highlighted that many schools have experienced funding cuts, and indeed participant 2 highlighted that a barrier to sustainable practice in school was due to resources being allocated to basic provision such as pens and books.

There were also an interesting variety of comments about student environmental activism. Interestingly, whilst participant 1's school has an eco-committee, pro-environmental facilities, and 'cycle to school' weeks, students seem to be potentially unaware of the existence of climate strikes, much less attending them. Yet, whilst participant 2's school had very little in terms of school provision for environmental activity, students were aware of, and did attend, the climate strikes. This could be due to a lack of cross-disciplinary focus for environmental education. For example, even if a school has a significant focus on sustainability, without viewing environmental education through the lens of government, politics or law, it may remain to students a

‘science’ issue alone, which is then fully dependent on their view of whether they consider themselves to be a scientist.

Additionally environmental action may be due to the culture of political activity in students’ lives. Participant 2’s school, not being far removed from Liverpool city centre, might experience higher numbers of students being involved in the climate strikes due to Liverpool’s strong history of political activism, more so than the surrounding regions. Whilst students involved could be highly committed to environmental issues, it is also possible that climate striking arises from a familiarity with political activism within the city, which encourages participation.

6.2.2 Delivery of the Future Food Challenge

Participant 1 had facilitated the Future Food Challenge in school twice before the third run was cancelled due to the pandemic. Participant 2 had delivered the challenge once fully and had begun a second time before it was also cancelled. Participant 3 was unable to deliver the challenge more than once as her students remain in her class for more than one year, but is keen to take part in the 2020-21 programme.

Topic	Participant responses
Why did teachers choose to facilitate the Future Food Challenge?	<p>Participant 1: “It gave the pupils an opportunity to complete a project unlike any other that we’ve done”</p> <p>“I think primarily I was looking to hopefully get like students like looking at STEM links, like in the wider world rather than, like I say, just sticking to the curriculum all of the time”</p> <p>“We really liked the fact that we could link to a local business, the university and make all those links, because we find in school it’s so much more appealing to the pupils when it’s like people who are quite young, people are from a similar background to them and like success stories, so we’re starting to incorporate that into our science capital more, we’re always trying to look for local people, local businesses, that’s something really inspiring and interesting to do, so it ticked loads of boxes for us really.”</p> <p>Participant 2: “I’d been made really excited by it all by that talk and I wanted to get the students who had been excited by it as well to continue with that, and realise like I did that you might think you’re doing a little bit, but there is so much more you can do.”</p> <p>Participant 3: “I wanted to do the Future Food Challenge because, it was going to be something that was so out of the ordinary and something that I knew that no one in school would have ever done, that it was so new that everybody would find it really interesting”</p> <p>“We have a huge focus on employability at our school, only 4% of people with disabilities nationally are in fulltime paid employment, so we are doing as much as we can to prepare our children and expose our children to the labour market and what goes on in the world of work... So I suppose a part of it for me was that I really liked the employability side, and I really liked the business side of it”</p> <p>“I think, I think what I wanted was some validation that what I know to be true is what other people are saying”</p>

Preparation	<p>Participant 1: “Yeah, absolutely no problems at all like I always think like the more resources the merrier so I was made up! Yes it was resourced brilliantly, no problems at all with that.”</p> <p>Participant 3: “No I loved it, I thought it was really, really good. I know that on some days when I was losing the will to live on something or other else, I was like right, this afternoon we’re doing the Future Food Challenge”</p>
Favourite part of delivering the programme	<p>Participant 1: “I think my favourite part was just seeing how engaged the students were with it, like they took a hold of it and came up with some creative ideas and just ran with it at the end they came up with some, you know, brilliant end products and I think the nicest thing was just seeing how proud they were of their achievements and they really had a sense that they’d done well and they’d made something that fit the purpose for the goal really”</p> <p>Participant 2: “I think it was from the build. Once we said, right, we’re committing to buying this stuff, and we’ve got to make this work, then they really, really got into it, and they moved it more.”</p> <p>Participant 3: “you don’t have that many opportunities to rub shoulders with mainstream peers within the school setting, because if anybody ever does come to school, it’s within a caring capacity...we never have anyone there who’s there to just be a peer... [on launch day] I watched [students from other schools] interacting with [her students] and it was all really, really nice. And those opportunities you know, they’re not quantifiable experiences, they’re just nice.”</p>
Most challenging aspect of delivering the programme	<p>Participant 1: “I think just the time. I think, like, obviously all the activities need to be done to make it a complete overall project but I think getting it done in an hour after school was really, really difficult. And erm, I’m probably if I’m honest, a little bit rigid, like I love a routine so I was trying to stick to it and get through it, so I think for me, keeping on track with the pupils was difficult. But if you said to the pupils it’s a two hour project every week, I think they’d engage with it and want to do it, but you know in the winter it gets dark and we try to keep it down to about an hour or so.”</p> <p>Participant 2: “I was, that was a bit hard in the beginning but then once they got into the build and they could see their idea coming together, it was brilliant”</p> <p>“There was a lot to get in. I think lots of the stuff, and I’ve been able to identify that better this year because of having done it last year, there’s so many brilliant opportunities thrown in there that you want them to get on board with it all, but you just can’t fit that all in one evening”</p> <p>Participant 3: “I suppose for me, I suppose the facilitating part for me on a personal level was relinquishing responsibility. Because when we got to the point where we were splitting into teams, I knew that I was the one with the background knowledge of this and I was sending members of staff away to lead a session for something that they had no overall knowledge of.”</p>
Positive reactions from students	<p>Participant 1: “Yeah, erm so, I think like you say, when they got feedback about the market research, they really enjoyed that because it felt like a real experience and it was a project that applied to people. I think in our first year as well, the pupils really liked doing research into how to get funding from charities.”</p>

	<p>“Oh obviously the pupils LOVE making the Pod so it’s the team, they all really enjoyed making it in the first few weeks. But then the ones that actually designed and built their own, they loved getting really hands on and building it, because the pupils were really, they’d come back up and say ‘we’ve done this today’ and they were amazed by it and really enjoyed seeing it.”</p> <p>“Also they really liked writing the pitch, which I didn’t think they would to be honest, I thought they might think ‘oooh’, obviously [another member of staff], who does the project, she worked with them a lot on that and helped them develop it, but I think they really liked the idea of trying to convince people that their idea was a good idea”</p> <p>“Whereas last year, I think they enjoyed more, like designing it, and trying to make it more, like, suitable for people their own age, they seemed to be more interested in younger people rather than the group who did it the first time round.”</p> <p>“Something our pupils loved finding out was all of the careers that people had before they worked at Farm Urban, they really, really loved that, that really engaged them”</p> <p>Participant 2: “the team that was working on that really got their heads together writing a script and who’s going to say what. And that really got them focused definitely”</p> <p>“Yeah, I think that particularly competition day just brings it all together so well, not even because they won, they enjoyed the day anyway”</p> <p>Participant 3: “[a student] was absolutely 100%, he had the investment into the fish, the investment into the water, checking on it”</p> <p>“They really enjoyed the DIY aspect of it and they enjoyed the building, and I mean everybody loves building don’t you because you start with a load of stuff on the floor and then you have something at the end.”</p>
Challenges for students	<p>Participant 1: “the only thing that we were a bit gutted was that we didn’t have time to do more of the Produce Pod activities, and I think they would have absolutely loved that. But obviously we were, to get to the end goal of the project you had to prioritise”</p> <p>“I think the one thing that we found a little bit difficult was drawing graphs, but I think that’s just a skill, it wasn’t that they didn’t want to do it, they just found it a little more difficult. Like you know when we got the data back, erm, like processing that.”</p> <p>Participant 2: “We didn’t get any negative feedback from pupils at any stage really. Sometimes we were frustrated because things weren’t, they weren’t completely sorted as fast as they wanted, or there’s little bumps in the road like we didn’t get research back from people they wrote letters to straight away, but again it was just a learning curve it wasn’t something that put them off really.”</p>
Involving other departments	<p>Participant 1: “The first year we did it all on our own, erm, up in science, but the second year like the pupils were like ‘oh if we go down to DT, sir will help us get the tools that we need’ and they, I think last year, our pupils designed it down, is it ECAD? Designed it down there, and one DT teacher really helped, and was really interested in the project as well, and really got involved like we were, so became part of the project.</p>

	<p>“So I feel like if I’ve taken on a project, I can’t say ‘oh by the way, I’ve done this and you need to help me this week’. I think it needs to be a little bit more collaborative in the future, and say like ‘we’re hoping to do this project, can anyone spare a few hours’. But the teacher who got involved was amazing, he was really, really interested in it and that helped the students get interested in it as well.”</p>
Meeting expectations	<p>Participant 1: “Yeah absolutely. Like pupils were engaged, they were really proud of their achievements, they got to an end goal where they made something collaboratively, and they got to think a lot more about the environment. So yeah, I think it definitely, like, ticked all our boxes and we were really, really pleased with the way the project ran for the pupils and us and the outcomes for them. Yeah, 100%.”</p> <p>Participant 3: “You know it turned out to be absolutely perfect. It ticked all the boxes of all the expectations that I thought of and more”</p> <p>“No I thought it was all absolutely fantastic. Any problems that we sort of encountered were all from our perspective because I was trying to bring four wheelchair users to the University of Liverpool, or any of those issues. I think that, we have in our employability strategy a box to tick that says ‘children will have an experience of attending an open day or attending a university’, and those eight children will be the only ones who will be able to have that ticked off by the time that they leave school, because University is just something that is just completely unattainable to our kids.”</p>

Table 17

When asking teachers why they wanted to take part in the Future Food Challenge, their answers largely fell into the same two main themes that students had identified – the environment and their future education and career. Participant 1 highlighted that she wanted the students to see STEM links ‘in the wider world’, but also because it provided an opportunity to hear more of what they like to hear – success stories. In making STEM links, participant 1 felt that students benefitted from hearing about someone from the same background as them achieving their goals. Participant 3 also was attracted to the programme because of employability, but this was particularly true for her school. As an SEN school, participant 3’s students have additional barriers into the workforce, and it was therefore developing skills relevant to employability that were important.

Participant 2 however was more attracted to the programme because after attending the TEDx talk herself, because by chance she was free that lesson, she was introduced to topics that she had not previously heard about and was inspired by the solutions. She wanted to come alongside students in learning more about environmental sustainability for food production together. Whilst participant 3 already had substantial knowledge of aquaponics, feeling that in school she was sometimes ‘fighting a losing battle’ it appears that another motivation for her was receiving support for facilitating environmental education, by the very nature of it being spoken about by someone other than herself.

Teachers were happy with the level of resource provided by the programme, and felt that the sessions did not provide an unmanageable amount of preparation on their part, indeed participant 3 turned to the Future Food Challenge as a good lesson choice when she was feeling demotivated during a school day. Participant 2 indicated that

more preparation was required the first year that she ran the programme as it was difficult to discern the priorities for each session, but she felt that she understood this more when she delivered the challenge a second time. Participant 1 agreed that there was a lot of content to get through in 12 sessions.

The most enjoyable aspect for all of the teachers was seeing their students become captivated by the topic, and demonstrate ownership by building their own system, or enacting leadership skills in sessions. Across the board students enjoyed building their system, and different groups enjoyed different aspects of the programme, for example, market research for some and writing the pitch or engaging with the Produce Pod for others. It would appear that the outward focus was an important aspect of the programme, as through the market research and presenting the pitch, students were interacting with people outside of school, and being listened to. Much like when several students identified in the TEDx talk feedback that it was meaningful for them to hear that a group of people cared about their future and were trying to help them, the students appear to benefit from feeling heard.

The main elements of the programme, which students found challenging include understanding the different project elements at the beginning of the programme and how to ‘get going’, time management due to the large amount of content, and some of the activities such as data processing, which was perhaps pitched academically at too high a level for some students. However, despite these challenges, the teachers said that students were able to overcome difficulties and it did not stop them from continuing to participate in the programme. Participant 1 identified that the programme benefitted from involving a teacher from another subject. It might be possible to further involve teachers from subjects that students might not ever be taught by, such as business studies or law, where there are relevant topics in the challenge to their discipline.

6.2.3 Skill and knowledge development

The following skills were highlighted in vivo, having been described by the participants as areas in which students developed their skills further:

Topic	Participant responses
Working as a team	<p>Participant 1: “in the first year I think we thought ‘aw, the girls have got together to be the creative designers because they feel like that’s’, but in fact we were wrong, but they had really gone into a group where they thought their strengths were most required. We didn’t really get too far with it in the third year but in the other two years. I feel that people really did have that ‘well this is what my skills are and I’d like to do this’”</p> <p>“There were people who got on it, because maybe forty/fifty pupils applied, there weren’t like groups of five that came together really, they knew each other but weren’t necessarily strong friendship groups at the beginning.”</p> <p>Participant 2: “I think both times most people seemed to choose a role that they felt suited to [when selecting to be a managing director, creative director or design engineer]. There was the odd pair here and there who were clearly not going to be separated. But I didn’t find that across the whole thing. And again interesting because last year they chose the roles</p>

	<p>before they'd done anything, and most of them put a role on their form and we had a pretty even split between the three."</p> <p>"This year we had the launch day first didn't we, and then they were picking their roles. I think they felt a lot more informed about what they were picking this year, definitely. But yeah I think most of them went on their own skills largely rather than picking to be with friends."</p> <p>Participant 3: "the groups that they ended up forming, weren't necessarily the friendship groups that they would usually spend time with so I thought that was quite nice... I thought it was really interesting that they'd had the opportunity to work with different kids than they would have ordinarily"</p> <p>"[member of class 1] decided that he wanted to be one of the design, er one of the building people, because he likes, he likes DIY, and [member of class 2] said he liked to do that because he loves cooking, and building, taking things apart and stuff like that and [member of class 3] is very good at directing, so he decided that he wanted to be a marketing person and even though he couldn't draw it, he could tell someone what to do"</p>
Leading a team	<p>Participant 1: "If I'm honest we pitched in a little bit, just purely because I know the students are really confident in using computers, but I was surprised, you know like, even just reading 'whenever it's in brown click it, give the team instructions', and the first few weeks we picked students who we thought were the most confident and they didn't mind saying 'oh you need to listen up now' or I think is such a big barrier because some pupils don't really like that limelight"</p> <p>"I think what we'd have to do with that is give pupils a little bit more forewarning. Obviously I know they're meant to know the week before, but you know, say, 'this is going to be a running programme, you are going to be the leader, just get yourself confident with the material online and you know, be ready, and we're here for support, ask us any questions but go for it'... We should have given the pupils a few more opportunities to do that to be honest. And we did give some of them the chance and they were brilliant, and others were like 'oh we don't want to do it' so it's just really reading the pupils a little bit better I suppose."</p> <p>Participant 2: "I think the team leader thing gave them all an opportunity to develop their confidence and that's a really good way to keep them all involved as well. Yeah, and I think that all the ones who have done it are proud of themselves that they've stood in front and done our job for a bit."</p> <p>"I don't know if that's made a difference but this year's team are very conscientious girls, less confident so some more apprehensive about being team leader, but really willing to give it a go and really leading it. Much more than the confident ones who bounced in, and were leading it because they wanted to be at the front, but then not giving much guidance. So it's been really interesting to watch, just by chance, two totally different groups of students."</p>
Finding a role	<p>Participant 1: "[at the launch day] they gave a bit of background to the type of job [different roles] and I think that really helped pupils to focus and think 'well actually, you know, if I was doing this, what area might I like to go to?'"</p> <p>"I think in both years we had one pupil who kind of strayed away a little bit, didn't feel like maybe they had a place in the team, and didn't feel like that they could maybe flourish as much as they would like to, and they ended up taking on like different roles, so I think in the first year, [member</p>

	<p>of class] he kind of lost his way a bit so he decided that he felt his skill set was like making a video so he started filming everything and made a little presentation and then, I think the second year, someone felt a little bit more like, I think in their head in the project, they thought they'd be doing a lot more with the Pod and the fish, and they became a little welfare manager of the fish and we just dealt with him that way really"</p>
Communication	<p>Participant 1: "Yeah I feel that communication is obviously a massive one, because even when they did the first pitch after they first wrote it they all stood there looking down and even the listeners were still colouring in, and didn't really give very much feedback. But the day before the morning of the competition they were pumped up with confidence, the audience who were listening were giving really active feedback, they were engaged and listening."</p> <p>Participant 3: "From my perspective, because my area of specialism is AAC and communication, everything that we were doing was through communication. So even if the outcome of the session was that we needed to have this done, we can't do that without communicating...So for me, [member of the class] being able to explain how aquaponics works was a huge plus. And I've actually used that video in conferences that I've presented at."</p> <p>"It allows the children the opportunity to hone their skills of explaining what [the Produce Pod] was and by the end of it, you know, by the time we had had it in the classroom for six months, they had it down! People were coming in and saying 'what's this thing with the lights? What are you growing there?' and the kids were like 'it's fish, fish poo, fish poo goes up, into the roots, plants grow, feed the plants, water goes down, fish poo goes over'."</p>
Knowledge about aquaponics	<p>Participant 3: "I know that they all had a really, really good understanding and baseline knowledge of how aquaponics works, erm, they all have an understanding of you know life and death and living things, and you know."</p>
Sales and marketing	<p>Participant 3: "I don't think the marketing aspect of it was really, that didn't really hit us as well as if we were mainstream and had that cognitive ability. Erm, I think the sales aspect and the fact that they thought that we could make money on it. Because what we were going to do, was we were going to sell them to the kitchen."</p>
Confidence	<p>Participant 2: "Definitely their confidence. Erm, their self-belief, which was lovely to watch. They were throwing their ideas around and someone agreeing with it, and building on it, and it happening that was lovely. And one part of it, the kind of mood board thing that they had to create was great because you could give value to everyone's ideas. It didn't matter that you then didn't do it."</p>
A mix of skills	<p>Participant 1: "So I feel like obviously communication really developed, confidence, teamwork, leadership, they all developed creative skills as well, and I think massively for our pupils a lot of social skills they developed. And I think primarily that was the most important one, in just, communication and social development I thought were really, really good."</p>
Does the school have a skills framework?	<p>Participant 1: "No, no it's not at all, erm, unfortunately because the project was cut short this year, I know [Farm Urban] showed us some really brilliant tools for mapping skills, but unfortunately we didn't use them at all, but it's definitely something that I'd like to spend more time looking at because they were brilliant. Just a really good way flagging up</p>

	<p>all the skills that you're developing within the lesson and that, I thought it was really good."</p> <p>Participant 2: "Not that I can think of, no. I don't think so... Yeah, scientific skills, there was focus on that within the science curriculum, that seems to have even moved away slightly. But I can't think of anything across the whole school that we, I hope not because I don't think I am if there is!"</p>
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Table 18

The most commonly articulated skills by students and staff throughout the Future Food Challenge are teamwork, leadership, communication and confidence. Creativity and social skills were also mentioned in these excerpts. The skills listed are all part of the Skillsbuilder framework, but the tools have not yet been utilised. Following the implementation of the framework, it will be interesting to hear whether students discuss a wider range of skills than has been discussed in this year's feedback, and perhaps further examples of how they exhibited their skills. None of the teachers interviewed identified that they had an existing skills framework that they utilised in school. Interestingly some students have identified other skills that they have and their relevance to the project, demonstrated when participant 1 highlighted a student who had made a film of the challenge's progress, for example. Students applying their passions to the topic that they are studying is much encouraged by Farm Urban and reflective of the Farm Urban team's own multidisciplinary nature.

6.2.4 Teaching practice

Topic	Participant responses
Changes to teaching practice resulting from taking part	<p>Participant 1: "well, as I say like it's definitely made me, hopefully put the sustainability environment more at the forefront, obviously that was something that we were doing when we were writing stuff but it's allowed me to make links to it hopefully a lot more easily."</p> <p>"And it's allowed me to find links that I maybe wouldn't have been able to find beforehand, you know because you always say like 'oh, what could you do as a job?' and I'm like, 'ooh I dunno', so I've looked into that more as a result of it and you know it's nice to be able to speak to people and say 'you don't have to do science all your life, you can come into it, there's loads of different pathways into it' and yeah. There's lots of different ways really, it's helped to develop me and make me think more."</p> <p>Participant 2: "I think again, what I mentioned earlier, up until that point the environmental that was, the classroom was really a curriculum point and we'd do it there, and I didn't necessarily look for those links elsewhere."</p> <p>"On the back of doing it last year, I was asked in school to go on a careers lead course and now I'm going to be a careers leader and give sort of the science part of it, so yeah loads! Loads has come of it for me! Definitely."</p> <p>Participant 3: "the staff learnt so much. My staff learnt so much, and my staff are really on board."</p> <p>"A big part of being a teacher is you have to know, you have to always be one level ahead of the kids, because you can't teach something that you don't know about yourself, so I thought it would be interesting and we'd all learn something, and it was!"</p>

	<p>“I did feel like because I was letting the learning support assistants go away with a group of children and lead on a whole session that erm, if I had have created the resources, I would have wanted them delivered in a very specific way”</p>
Pressures on teachers	<p>Participant 1: “I suppose just, helping pupils to achieve what they’re capable of. I suppose like, yeah my biggest anxiety would be pupils not getting the grades that they’re capable of and maybe holding myself accountable for why they didn’t I suppose.”</p> <p>Participant 3: “very irregularly, do I really contemplate - and the reason that I don’t is because I’d get so stressed out I’d stop thinking about it - contemplate that how influential I am on those young people. Erm and that everything I’m saying throughout every single day, you know, they’re just little sponges and they can take everything in and they can listen to it, or not”</p>
Biggest priority as a teacher	<p>Participant 1: “Yeah, I think it’s really that pupils leave feeling good about themselves and that they’ve achieved something, and they can, you know, come in the next day feeling like they can do it again... Just to give them confidence to be able to do it and want to do it really.”</p> <p>Participant 2: “the actual knowledge education part is becoming less important to me, and more the how to be a good person. And things like the environment and the global I don’t know, issues, situation, tolerances, you know, obviously education is important and I still enjoy teaching that and the knowledge. But I just kind of feel that there’s so much else, particularly at secondary school they come in when they’re 11 and they leave at 18, I mean they’re adults. I want them to leave as reasonable adults who know how to treat each other. I’m finding that more and more of an issue”</p>

Table 19

A primary aspect of the challenge that was identified by teachers as impacting their teaching practice was being able to identify a wider range of links between environmental topics and their day-to-day lives. This could include the topics that they are choosing when writing their school curriculum; thinking outside of a scientific framework for understanding environmental issues and developing further knowledge of career options. Participant 2 even adopting practices outside of her teaching practice such as growing food at home as an additional outcome.

Another element to the programme that diversified the teachers’ traditional pedagogy was relinquishing responsibility during the sessions – whether this was to students as team leaders, or other members of staff. There can be a tension between Farm Urban’s design of the programme to make it possible for teachers to know very little about a subject before they discover it with the students, and the teachers’ desire to know what they are going to be teaching in advance. As mentioned in chapter 3, students are used to finding an answer in a textbook or asking a teacher, so it is a large pedagogical shift for both students and teachers to let go of these traditional methods of finding answers. Whilst some teachers enjoyed learning with the students, other teachers still felt more comfortable knowing the subject content before sessions, which is why EcoVerse incorporated the ability for teachers to look ahead at content before students could see it. However, this could be an interesting area for more research for the purposes of facilitating continuing professional development.

6.2.5 Technology

Participants had differing levels of embedded IT infrastructure in their schools, and also had used Farm Urban's initial Future Food Challenge website in different ways. Only participants 1 and 2 had used the new platform at all however they had to stop the Future Food Challenge after three weeks when schools were closed as a result of the pandemic.

Topic	Participant responses
Issues with the Future Food Challenge	<p>Participant 1: "Because [a lack of laptops is] just what gets in the way at the moment, it's not that we don't want to do it, it's just that, and unfortunately it really like makes the start of the session quite like long and drawn out because two people will be on, then four people's aren't working, then they go to it and it's just, it doesn't make the best start. So we often start at the front, then say, if there's any laptops then you can do research, but we mainly do it from the front."</p> <p>Participant 3: "the only problem that we had, which is a really, really minor one, was that the children's laptops, because obviously I did the main one on the computer with the big screen, and then when they had to go off and split into teams erm, we had to get it unblocked from the technician because the kids laptops and the kids laptops accounts are like so, clamped down for security"</p> <p>"I think that we're in, we're in a, a unique position that we're pretty well served for computers, and accessing laptops wasn't a problem for us, erm but I can see that in mainstream schools where in that classroom there is only the teacher's laptop and the screen, people bringing laptops from other places may have been a difficulty. But for us, that wasn't an issue."</p>
IT infrastructure	<p>Participant 1: "We got a new leader of IT support in and, I think I spoke to her maybe in October, and said like 'it's a long time coming school it really needs it', and that wasn't a criticism of the school, it was just in terms of funding that we've got available. We were talking today in school actually, and were saying that it's such a shame we didn't have Google Docs and stuff before lockdown because then we would have had a completely different expectation on pupils' communication through like you know, from home and stuff like that, but it's one of them things and we're hoping to get it up sooner rather than later, so we had a meeting today about how to use docs and slides and stuff so it might be a different picture next year, where pupils can access it a little more easily."</p> <p>Participant 2: "Great, I mean they haven't always, we've got a science bag of iPads somewhere, which we get them, they're often not charged and things. So we weren't always able to say 'everyone go off and log on and do this', we more tended to stay on my laptop and do it on the projector, which has meant, because we never got to the point this year of the groups breaking away."</p> <p>Participant 3: "Erm, I mean in school we have everything we need"</p>
Using technology at home	<p>Participant 3: "this pandemic has highlighted to us the lack of technology available to children at home... so I put a grant application in for the fourth or fifth week of lockdown, put a grant application in for 15 laptops... Some people were very grateful and they accepted it, and said that they would be able to connect it to the internet and they would be able to log on. And for some families I was standing outside their kitchen window for over an hour</p>

	<p>trying to describe to them how to use a trackpad on a laptop because they just had zero access to technology. And I suppose that adults who have zero access to technology then raise children who have zero access to technology, it becomes a self fulfilling prophecy doesn't it?"</p> <p>"I think that of the children that we've given laptops to, probably over half to three quarters of them have accessed the things we asked them to access, and that they just needed a physical piece of equipment in order to do that"</p>
Using the EcoVerse platform	<p>Participant 1: "Sorry no, I'm sure it was all brilliant, and I'm sure there'd be nothing I could suggest to improve, but I think it was just, on the day it was really exciting finding all the different things, but three weeks in we had to stop unfortunately. So, we've not done it since really."</p> <p>"Yeah. I think, when you couldn't complete some things, and it was because of me, I don't think I'd clicked certain things were done, so I think I emailed a few times saying 'aaah' but I'm sure the pupils would be a lot more confident at that than we are maybe."</p> <p>Participant 2: "That new platform is brilliant, to be able to see, like I said earlier, there were loads of things in it that were opportunities, but didn't have to be done and it made it so clear for me as well, to make sure, this is what we have to have done. Because you get to a point around 4pm as well where some of them are saying 'I need to go, I've got to get picked up in 15 minutes' and you go 'well okay we've got to do these, and anyone who wants to stay can stay and we'll carry on with the other stuff' or whatever, so yeah that was brilliant."</p> <p>"Having their own login on the platform would have worked well for that and if we'd got our iPads sorted or, I never took them up to a computer room, which I perhaps should have last year and then that would have facilitated that, but again last years team, some may have gone off task. This year we wouldn't have had a problem, we would have gone to the computer room, and they would have all cracked away in their teams doing what they had to do. So yeah, the infrastructure is there, I probably didn't make best use of it last year.</p> <p>"Yeah, I think that some would, [continue working on the challenge at home] not all of them, but I think some would yeah, and it would just be us dipping in to the right extent in the lesson to get their interest and then saying 'you can do this'.</p> <p>Participant 3: "I think we used the right amount of technology because I am also aware that sometimes you can have overkill with technology."</p>
Using technology in lessons	<p>Participant 1: "No, we use laptops erm, or during lockdown I've sent out a Kahoot! quiz to my year 10s to see who's been doing it, and we've got Seneca as well, Seneca is just like you can up, no you don't even upload them, it's all just pre-programmed on there, you just select activities for pupils to do"</p> <p>"We don't have a huge amount of laptops and every time we use laptops and it is just one of those things, it takes like 15 minutes to get logged on, then the internet's not working"</p> <p>Participant 2: "Not really no, with phones being an issue in your lesson, it has to just be nothing to do with them. There's been times over the years school have bought things, we bought some quiz thing and had handsets to be given out but I've not used it in class."</p>

	<p>“You’re so pressured with what you’ve got to get out of them, everything you’re doing you’ve got to weigh it all up, you know, ‘what are we going to get out of this’ and if it’s five minutes of a lesson yet it’s going to take twenty minutes to get them working it and then on task and all the rest of it, it’s, yeah, it usually doesn’t manage to outweigh the more laptop and talk discussion forms of teaching really.”</p>
Developing skills in technology through the Future Food Challenge	<p>Participant 1: “Yeah, I mean obviously before I had really limited use of programmes, apps and platforms, and stuff like that, it has really helped me become a little bit of a better communicator in systems and programmes that I never ever would have used before, and like, unfortunately we haven’t had much use of the new one, but that was like when I started that would help me develop a lot further as well.”</p>
Working without wraparound support	<p>Participant 1: “Yeah, so I think me and [another member of staff] were saying like, from our point of view, like how we run it there’s still quite a large amount of teacher input using the current model. Purely from the vast amount of work that has to be completed, so we helped pupils prioritise work, make targets, but erm, it was set up slightly differently like the one that they’ve sent out for like schools to have a go [over the summer], I’m sure that would be really manageable for pupils in smaller chunks, reducing the size of the project and making really smart targets for them, I’m sure there’d be no reason why they could achieve that like online without support from teachers.”</p> <p>“I think that something that we’ve like as a school found always really brilliant from the project though is when Paul and then team [from Farm Urban] come in, because we’ve said at the beginning that it’s a real way for pupils to see businesses in the local community being successful, being interested in science and you know solving real life problems, so it would still be great if it was a remote programme that there would be some interaction with the team, purely because they’re so engaging with our pupils and really relate to them and I think really that has a big impact on the number of pupils that apply to do it. If I just stood at the front and was like, ‘there’s a project coming’, it would be nowhere near the same amount of pupils interested in doing it, so it would be great if that part could still exist really.”</p> <p>Participant 2: “I think it could work remotely, I’m wondering how many are going to sign up remotely...But I wish [for the trialled remote summer FFC] we had that chance in school to say ‘listen, there’s this thing you can do and it’ll be great’, then I think it would be great, but I just think getting that message to them that it’s there is the hardest part really.”</p>

Table 20

As the literature review highlighted, where schools may have a significant level of IT infrastructure, it may not be worthwhile for teachers to use technology in their lessons due to the time that it takes to set up laptops, or connect to the internet, for example. All teachers used the existing Future Food Challenge website, however it was mainly used by the teacher at the front of the classroom, than by students on their own devices. Teachers appreciated the potential for individual logins and the new platform to change this, however this would require more preparation for the teachers in ensuring that the students attended the computer suite or that laptops were prepared.

It is possible that IT infrastructure will develop quickly as a response to the pandemic, as it was highlighted by all teachers that much more is communicated to students via

technology as they work from home than has previously been. Despite additional barriers for SEN students in education, participant 3's school had the facilities they needed in school without problem, and a greater access to tablets or computers, however a significant number of her class did not have any access to technology at home, which required intervention from the school.

In order for teachers to fully utilise the potential of the new platform, it is important for Farm Urban to communicate *why* the EcoVerse tool is useful, not only for delivering content, but alongside other tools such as Slack or Asana, for significantly enhancing students' digital literacy. This may be an additional area for resourcing continuing professional development as, for example, participant 1 highlighted that she felt that students would be more comfortable with the use of technology than she would herself.

6.2.6 Other relevant topics

Topic	Participant responses
Engaging with the food in the Produce Pod	<p>Participant 1: “yeah if [Farm Urban] had something like that [more resources for other year activities] it would be incredible, and then we could have like a mini club, like year 7 aquaponics club or something like that, that would be really, really good. With certificates or like yeah because we have quite a few pupils come to science club each week, and you know, if we got them engaged with that early, you know, we do a little bit, we tell them what it's about, and they come and have a look at the fish and we chat about how the herbs are growing, but we don't do a lot more than that in year 7 with the pupils because we're doing another project, but we'd be happy, we'd really love to run something along year 9 with the 7s that would be really good.</p> <p>Participant 3: “So we all did try the salad, and we all, and I've got a couple of children who are, I was about to say nil by mouth, but don't eat, they can eat, they just choose not to from autism. Erm, so we all tried it... we were picking lettuces that we had painstakingly grown, and they were like mashing them in their hands and I was like ‘that is such a waste of a lettuce, home grown, not in plastic, no air miles, the freshest lettuce you're going to get’ but then I thought ‘that's where they're up to and they're probably not going to put it in their mouths and they're probably not going to eat it, but they've got it in their hands and they've, you know, maybe they'll put their fingers in their mouth in a little minute and get some vitamins, erm, [laughter] I don't know”</p>
Pressing issues for year 9 students	<p>Participant 1: “I think social media is a massive one. Really, really big, and I think believe it or not even in year 9 there's a lot of pupils who are, who feel the anxiety of exam pressure. Erm, you know early on and, you know, you might not necessarily think it but it's definitely on their minds. But yeah, definitely social media. I think probably relationships is something that's on their mind and like their identities, I imagine, is something that erm is something that, they do worry about. But I couldn't say specifically really.”</p>

Table 21

The literature review discussed other pressures that might affect young people and understandably move their focus away from environmental issues. Participant 1 highlights some of the pressures that might affect year 9 students, including the pressure of exams even before they have embarked upon their GCSE year. The

potential for enhancing wellbeing through engagement with green infrastructure has been discussed, and could be a useful tool for students managing stress and anxiety. Environmental content must come alongside other issues where possible to provide solutions for pressures on young people, and those facilitating low carbon education must not shy away from a holistic view of where environmental education intersects with other socioeconomic challenges affecting young people.

Despite how many students indicated that they had taken messages regarding food production and consumption away from the TEDx talk as the most important message there is surprisingly little mention of changes in behaviour relating to food through the interviews. This naturally could be because of the separation between teachers and students during times where food decisions are made, for example dinner times or food buying choices. This could also be because the Produce Pod activities are often neglected due to the need for students to complete other tasks to keep on track for the overall programme. The school that engaged most obviously with the produce itself was participant 3's school, for whose students the sensory aspects of having the Produce Pod in the classroom was of great importance.

Whilst it would be interesting to gather information specifically on how students' eating behaviours are or are not affected by participation in the project, it is important to reflect on whether one of the overall aims of the project - to reconnect students with healthy, locally grown food - is being met. Participant 1 expressed interest in more content for other year groups who show interest in the Produce Pod, as it is in their classroom as they work. There is potential for Farm Urban and EcoVerse to utilise the opportunity for all students seeing the Produce Pod to facilitate more discussion around food and provide further content to enhance the relationship between students' interaction with the Produce Pod and their own food choices.

7. Discussion

7.1 Interpreting the data

The data, which has been analysed in the previous chapter, gives useful insight into the responses to environmental education from students and teachers in Merseyside. After listening to Farm Urban's TEDx talk, the majority of students explained their thoughts and reflections about the environment, food production and food consumption. Students also considered their personal future and recognised the need for change in human lifestyle and behaviour. Students contributed either a reflection, an emotional response or identified a specific action response to the information that they had heard.

Farm Urban was able to obtain feedback from 1,204 participants from schools in Merseyside after they had heard the TEDx talk. All feedback forms were analysed and three interviews were conducted with teachers, who facilitated the challenge for a combined number of 33 students. We can use the data gathered to understand in part the reflections and experiences of students. We can also draw conclusions from the fact that out of 1,204 participants who heard the TED talk 86 students were selected from all applicants to take part in the Future Food Challenge (not including all UTC students who ran their own challenges in enrichment lessons). Participant 1 (teacher) also commented that there were 40-50 applicants to the challenge. The literature review has identified that many students are eager to learn more about and engage with environmental issues, which has largely been corroborated by this dataset.

The schools that participated in the Future Food Challenge had varying experiences of engaging with the environment within their school building. Whilst there were students that attended schools with farms and wind turbines, other schools did not facilitate recycling. As the data did not identify demographics, it was unfortunately not possible to analyse the difference in responses to environmental education between schools with features for sustainability (e.g. school 1) compared to those without (e.g. school 2). However school 1 did not see student engagement in political eco-activism, where school 2 did. Further comparative research regarding this concept would be interesting, as it is not possible to determine other areas of pro-environmental behaviours between school 1 and school 2 without demographic information.

It was, however, clear that all teachers who were interviewed did not feel that environmental education was salient in curriculum subjects or in examinations, which reflected the findings of the literature review. Curriculum content was largely described as 'dry' or removed from the daily realities of student's lives. Teachers have witnessed that students respond well when their science studies are linked to local businesses, job options, or an interesting development that they have seen on the news. However, it is time consuming for teachers to develop up to date content of this nature. Resultantly, teachers were attracted to the Future Food Challenge for the pre-prepared content, but significantly more because of the excitement and engagement that it stimulated in their students.

The data indicated that students were least likely to articulate their plans for the future compared to their consideration of various environmental issues. Additionally, whilst a significant number of students considered messages around food production and consumption to be the most important, attitudes towards healthy eating were not raised within the teacher interviews.

A section of the TEDx talk discusses how despite significant biomedical advances; a top down approach to healthcare is not addressing the various diet related diseases affecting the health of the population. During this section of the TEDx talk, the speaker considers a bottom up approach to complement advances in medical science, which reflects upon the relationship between food and both physical and mental wellbeing. However, improving mental wellbeing is not a theme that is significantly referenced in student or teacher feedback. This is a significant aspect of the rationale behind the project, as it was evident from the time that I spent shadowing Farm Urban that the organisation has a strongly held belief in the importance of reconnecting with nature, including food, for our wellbeing. It is therefore interesting that this theme did not emerge substantially in the data analysis.

Due to the cancellation of the Future Food Challenge in 2020, it has not been possible to gather data about students' own perceptions of their experience of the Future Food Challenge using the EcoVerse platform. Such feedback from students could have indicated more consideration of reconnecting with nature for improved wellbeing, where discussion of this was absent from teacher interviews. However, it would be worthwhile for Farm Urban and EcoVerse to reflect upon how to encourage further engagement with such themes that are important to the ethos of both organisations, but have not emerged as salient themes identified by participants in the data.

The teachers' responses regarding their use of technology in school reiterated the external and internal barriers to EdTech as discussed in the literature review. It is evident that there has been some success in this area, as whilst teachers did not use the website to its full potential, the teachers interviewed did indicate its use each week. Participant 1 also identified increased confidence in using technology:

“Obviously before I had really limited use of programmes, apps and platforms, and stuff like that, it has really helped me become a little bit of a better communicator in systems and programmes that I never ever would have used before”

It was highlighted in participant 3's interview that despite the barriers to inclusivity that often affect SEN schools, school 3 appeared to have a stronger IT infrastructure than the schools 1 and 2, due to the need for devices for communication. The use of tablets, laptops and interactive whiteboards equipped to support augmentative alternative communication is life changing for students who can access such technology. Such applications increasingly aid students in voicing their opinions. However, apps specific to AAC or to improve learning outcomes for SEN students were not common to most lists for ranking or reviewing commonly used EdTech resources.

The literature review highlighted that EdTech can both narrow and widen socioeconomic gaps – by facilitating access to high quality education resources and

utilising different learning styles, or by discriminating against pupils who have less access to technology. Interviews with teachers highlighted that each school had different levels of IT infrastructure in their schools, or levels of engagement from teachers with the IT that was available. Farm Urban and EcoVerse may therefore want to reflect on how the programme can further deconstruct barriers to EdTech use, or problem solve for issues resulting in less engagement with their EdTech product.

It is evident from the data that Farm Urban's Future Food Challenge has been immensely successful in raising student, and teacher, awareness of the unsustainability of food production methods, and alerting them to the potential of urban farming as a solution. The students expressed that they wished to learn new skills and information in the TEDx talk feedback, and indeed teachers fed back that a significant positive outcome of the challenge was the development of students' skills. It is also evident that students have also been able to take pride in their own innovations in a developing field. Having now implemented a skills framework, developed more supporting resources and created a user friendly platform to direct students through the programme and host content, it will be exciting to gather further data to monitor the impact of these additional features of the programme.

This data serves as a contribution to research about environmental education. Whilst providing a dataset about the responses of students and teachers in Merseyside about environmental education, which can be built upon further, the data can also contribute to a national narrative. The data is useful within the context of the climate crisis and increased student participation in eco-activism.

7.2 Answering the research question

This research started by looking at the following five questions:

1. To what extent do educational stakeholders prioritise environmental education in Merseyside schools?
2. What pedagogical methods have been used successfully to equip students to build a low carbon future?
3. What are the barriers to providing environmental education in Merseyside schools?
4. How is EdTech currently used to provide solutions for educational aims?
5. How can Farm Urban's Future Food Challenge and the EcoVerse platform be effectively developed to equip Merseyside's students to solve future food problems?

Through the development of a theoretical framework, these questions were refined to one specific research question:

Can environmental education be successfully facilitated through an EdTech tool to build a low carbon future?

The data has provided answers from different viewpoints – through demonstrating student response to an environmental topic, to understanding teacher's experiences of facilitating environmental education through a basic EdTech tool.

It is important to clarify what is meant by ‘success’ as the data is interpreted. Environmental education was delivered through an EdTech product; therefore it is possible to do so. The initial independent evaluation of the Future Food Challenge identified that students found the programme enjoyable and useful, and that students developed both knowledge and skills by undertaking the challenge. The generation of knowledge and skills could certainly be interpreted as successful, and this was only possible through the facilitation of the programme using an online resource, delivered by teachers. However, the data elucidates the further ways that we could consider the delivery of environmental education through an EdTech tool as successful.

Knowledge

The Teach the Future student movement states that ‘our learning needs to reflect the severity of the climate crisis’. The TEDx talk feedback showed that 77% of students expressed a reflection or suggestion for action about the environment, indicating that a transfer of knowledge for environmental education took place for over three quarters of participants. Other students took away messages regarding their health, future, the need for a change in behaviour and more, only 3% of students did not articulate that they found the talk useful, whilst only 1% explicitly said that they did not. The teachers interviewed felt that through the Future Food Challenge, they felt better equipped to link environmental education to curriculum topics.

Positive emotional response

Whilst it may be unexpected due to the subject content, students largely responded reflectively and positively to the information in the TEDx talk. Many students expressed feelings of hope and when considering opportunities for the future said that they personally wanted to be a part of positive change. Students often considered that urban farming, or specifically aquaponics, seemed like a positive way to address future food problems, and it could therefore be considered that students could remain positive about the subject content when they were presented with possible solutions.

Taking responsibility

Considering the possibility that students exhibit a positive response to climate change when presented with potential solutions, whilst it could be considered that older generations are burdening the younger with the task of solving problems relating to previous negligence, empowering students to problem solve could address potential eco-anxiety. Breaking down the responsibility from ‘they’, for example ‘the government’, has the potential to circumvent pessimism in students and equip them to engage with the issues directly affecting them. As demonstrated in the interviews, teachers also benefit from seeing their students captivated by a subject and innovating their own solutions.

Feeling valued

The TEDx talk feedback included specific references to students being emotionally moved that an organisation cared about their future. Similarly, participant 2 (teacher) said in her interview that an important aspect of the Future Food Programme for her was seeing the development of the students’ self-belief when their ideas were listened

to. Participant 2 identified that through activities such as creating the mood board, even if a student's idea was not taken forward, being able to recognise that their contribution had been part of the creative process helped students to stay committed to their team and engaged throughout the programme.

Each of these outcomes can be considered to be successful, as there is inherent good in each for students, teachers, schools and families. Whilst the TEDx talk feedback shows evidence of the environmental knowledge content requested by students through movements such as Teach the Future being successfully received by the majority of students, the teacher interviews demonstrate the success of delivering environmental education through an EdTech product. The research question, however, considers that success should result in the building of a low carbon future. It is not yet possible to say whether a low carbon future can be facilitated, as we have no way to tell what is yet to happen. We can however recognise that action must be taken, and therefore the theoretical framework was developed in an attempt to understand what might provoke an action response.

Facilitating an action response

The cycles of research have all contributed to the development of an EdTech product designed to encourage an action response in participants of a programme about low carbon technology. As it was not possible to complete the third cycle of research as intended, we must interpret the data to understand, according to the theoretical framework, whether the conditions to facilitate an action response are present.

Various elements of the Future Food Challenge and EcoVerse platform can easily be mapped on to the theoretical framework, which will hopefully fulfil the conditions required to result in students exhibiting an action response. However, an area that clearly requires further development is in enhancing inclusivity. This will require collaboration with groups with additional barriers to pro-environmental inclusion resulting from phenomena such as socio-economic injustice.

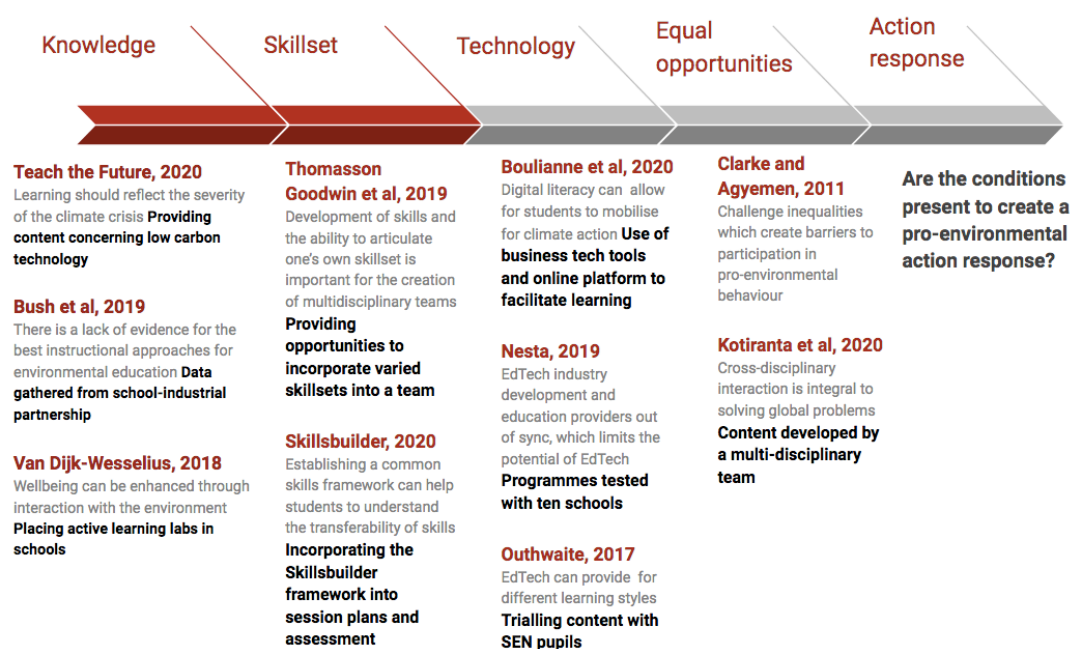


Figure 23 – The EcoVerse programme mapped onto the theoretical framework

Working backwards from the theoretical framework the majority of conditions can be seen to have been met, however to understand whether an action response has truly been facilitated, further longitudinal studies must be undertaken.

7.3 Developing a methodological framework

The project brief for developing EcoVerse’s EdTech product stipulated that the research should ‘develop an educational framework for the delivery of content which is transferable to different low carbon technologies and alternate audiences’.

Whilst the theoretical framework can be used for product development, I have produced a further visual representation of a methodological framework for the delivery of content.

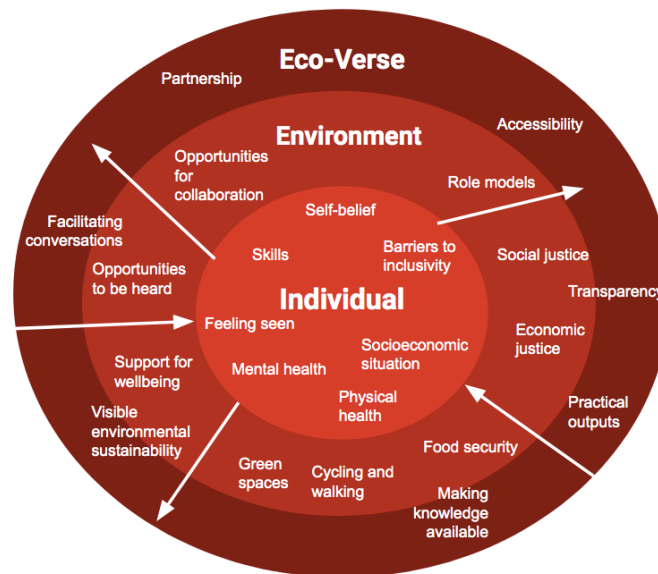


Figure 24 – a methodological framework for other low carbon tech and alternate audiences

Whilst the core circle should always be the primary driver for educational content, the educational framework is also non-linear. The individual, i.e. any learner accessing EcoVerse programmes, should inform the needs of programmes, and their voice should be evident throughout all product development. Consideration should also be given to the environment of participants, and how the product can challenge inequality or promote a positive environment for an individual or cohort, helping to resolve barriers for the individual. Finally the product itself should be accessible for users, collaborative with participants and groups relevant to the project to promote quality and inclusivity and should always result in a practical output, thereby facilitating the user’s first action response.

For example, considering the Future Food Challenge in the context of the educational framework, data was collected via feedback forms and interviews, and it has been noted that future data collection should, where possible, incorporate more demographic information. Through the Future Food Challenge, schools are also provided with living labs to bring fresh produce and an ecosystem to classrooms for

students to engage with, to promote good mental health. Teaching students to grow their own food indoors also has the potential to enhance the availability of fresh nutritious food to families, although naturally such efforts must be in conjunction with all efforts to alleviate food poverty. To provide role models within the students' environment, Farm Urban also provided an opportunity to meet scientists to demonstrate the range of journeys into science. This opportunity, and others throughout the programme, allowed for the thoughts and opinions of students to be heard.

Finally, the EdTech tool provided information for students, which allowed them to grasp the concepts being discussed, and develop skills to support their learning. Students built their own prototype aquaponics system, a visible piece of sustainable infrastructure, which then enhanced their environment, and helped students to believe in their own abilities. In summary, the programme was developed through consideration of the participants' needs, engaged with their environment, and the final product facilitated positive changes to students' environment and promoted opportunities for individual growth.

The framework is wide reaching in its aims, as it is built around the concept of engaging with multiple issues at once to facilitate environmental education. It is fair to consider that engagement with wider socioeconomic considerations is overextending the remit of what the platform can achieve. However, as much of the framework is based on collaboration, it is not the intention that EcoVerse seeks to singlehandedly address all socioeconomic issues. It has rather been identified that whilst students are experiencing food poverty and other significant pressures, they will be unable to engage fully with environmental education. Therefore possible intersections between low carbon educational programmes and opportunities for reducing socioeconomic inequality should always be considered. This may be regarding food insecurity, skills for a green workforce or sustainable energy production, for example.

This framework can be used for the development of content for other low carbon technologies and alternate audiences.

Individual	Environment	Eco-Verse
<ul style="list-style-type: none"> • Asking individuals for feedback about their needs and reviewing relevant literature relating to a target audience • Examining potential barriers to inclusivity • Understanding relevant socioeconomic factors 	<ul style="list-style-type: none"> • Understanding how the low carbon technology can be embedded into the individual's environment • Providing opportunities for collaboration and partnership working with relevant groups • Understanding inequality within an individual's environment 	<ul style="list-style-type: none"> • Making knowledge available about the low carbon technology • Embedding the skills framework throughout programme content • Programme content leading towards the development of a small scale low carbon product • Relating the programme content to opportunities to reduce inequality

Figure 25

Further research must be conducted to test the validity of the theoretical and methodological frameworks to ensure that action responses can be facilitated to build a low carbon future through EcoVerse's EdTech product.

7.4 Reflections on the research design

An Action Research methodology was adopted to conduct this research. This research design was chosen, as the industry-school collaboration that exists between Farm Urban and Liverpool Life Sciences UTC is rare, and as such there is limited research about such partnerships and the resultant educational outcomes. The literature review recognised a lack of evidence for the best instructional approaches in environmental education. To avoid duplication of the first evaluation, which very comprehensively explored the strengths and weaknesses of the programme, this research instead sought to engage with wider issues around environmental education and education technology to provide further context to the development of EcoVerse's EdTech tool.

Volunteering with Farm Urban and EcoVerse for the research was beneficial in many ways. The cultures of the organisations and what they were trying to achieve through their educational programmes was explored. Reflexivity was practiced able to consider the researcher's reactions to the educational content, and indeed personal changes in behaviour including food, product and transport choices. Personal experience, alongside the data collection and observations, was helpful in developing the educational framework.

The delivery of pilot programmes with the UTC or refined programmes with the participants of the Future Food Challenge was witnessed. This helped to shape an understanding of what was working well in classrooms and at events for students and teachers, as well as the time investment required from Farm Urban and EcoVerse. Visiting different schools enabled consideration of how facilitators adapted the content to their own style of delivery, and visiting an SEN school was particularly informative about how the programme could be adapted for different learning needs.

Resources were developed to fill any gaps in support for students or teachers, and conceptualise the way that the programme could develop to enhance its accessibility.

The theoretical framework was developed to suggest the conditions that need to be present to facilitate a pro-environmental action response in students through the EcoVerse EdTech tool. The methodological framework was further developed to understand how the tool could be adapted for other low carbon technologies and alternate audiences. As discussed, there was a change in research design due to school closures, which prevented data collection from students whom had undertaken the challenge and therefore limited the opportunity to test the theoretical framework. However, the Grounded Theory approach to coding the TEDx talk feedback proved useful in understanding students responses to environmental education, and therefore contributed to the development of the methodological framework.

The change in available data highlighted one negative aspect of the research design as the data analysis became more highly dependent on teacher interviews. Firstly, the number of interviews was fewer than would have usually been conducted. Despite the fact that teachers had primarily been proactive and communicative through the Future Food Challenge, a small number of responses to the request to interview were anticipated, as teachers were dealing with new pressures on their time due to the pandemic. It was also not possible to recruit more participants for interviews, as there was only a pool of ten teachers in total who had facilitated the challenge.

Another disadvantage of the research design was that teachers had met the researcher in the context of volunteering with Farm Urban, which could have affected the feedback in interviews, as teachers may have been reluctant to give negative feedback. However, due to the specificity of the responses given about the positive outcomes and challenges of the programme, the data can be considered to provide worthwhile feedback, which has been integral in exploring the research question.

7.5 Limitations of the research

This thesis sought to examine how educational content regarding a low carbon technology, within the context of the UK's dependence on carbon, could affect pro-environmental behaviour change to build a low carbon future. Global carbon use is so extensive that it would have been impossible to discuss the wide range of factors affecting carbon emissions in this thesis. Whilst an educational programme exploring aquaponic and hydroponic farming methods was chosen as a low carbon technology to be hosted on the EcoVerse platform, the sustainability of agriculture is still far too large a topic to have been discussed in any detail within the remit of this thesis. This could be considered to be a limitation for this research, as it is exploring only one aspect of carbon emission reduction and agriculture amidst many inseparable factors. However, it is envisaged that EcoVerse will host other programmes alongside the Future Food Challenge. This will form a modular approach whereby schools/organisations/individuals will have access to information about a wide range of low carbon initiatives, each structured to best equip students to develop the skills and passion required to take action.

The most notable and disruptive challenge for this research was the cancellation of the Future Food Challenge due to the COVID-19 pandemic. Where it was originally

anticipated that feedback would be gathered from students and teachers throughout the Future Food Challenge, no school was able to complete more than three weeks of the programme before schools were closed. Whilst being unable to complete the original research plan was disappointing, an alternative dataset had already been identified in the planning stages of the thesis. The TEDx talk feedback, which would be useful for the project and worth further analysis, had been ruled out previously due to the limited timescale for completing the research. Subsequently revisiting the TEDx talk feedback upon changing the data collection plan due to the pandemic allowed more time to reflect specifically on a more general student response to environmental education, which is an identified gap in discourse.

These reflections have undoubtedly shaped the product development positively by testing the theoretical framework, through indicating the extent to which students articulated 'action responses' following the TEDx talk. Within the remit of this thesis it was only possible for one researcher to code the data, it was not plausible to use multiple coders, which would have enhanced the quality of the research by testing the validity of the codes. The coding book has been provided in appendix 6, which was created to promote consistency, however future consideration of the dataset would benefit from employing additional coders.

There were limitations in terms of the TEDx talk data, for example, the lack of demographic information available from the TEDx talk feedback forms. From the feedback forms, it is only possible to know the age bracket and regional areas within which participants live. For future data gathering for the Future Food Challenge, information about the demographics would be helpful. It would be interesting to gain more data from each TEDx talk delivery, such as the attitudes of students before hearing the talk, and also to gain longitudinal data about whether students have implemented the steps they outlined to achieve their future goals, or the pro-environmental activities that they identified that they could take.

Recognising that the raw data from previous years was handwritten and would be time consuming to process, for the 2019 TEDx talk delivery, a Google form survey in order to anonymously gather student survey responses following the talk was designed. Unfortunately, as students were not allowed their phones in assembly, they were provided with a link to complete the survey at a later time. The amount of responses obtained from the online survey was negligible, and for the remainder of the schools paper forms were returned to, which increased the time for processing the raw data significantly.

A further limitation resulted from being unable to complete further statistical analysis of the data. This arose due to a fault when a query was run using NVivo. This resulted in anomalies in the number of references at each code, which it was not possible to resolve. The query was run to produce a binary script of whether a response was coded at a node or not, for example, whether a student's answer had been coded as 'concern for human welfare' or not. However, when the script was compared to the original format on NVivo, it appeared to suggest that some answers had been coded at nodes that they had not been. The dataset was too large to complete this analysis manually within the timeframe. It was therefore not possible to incorporate the chi-square tests as planned, as their validity was questionable. Further statistical analysis of the data gathered will be interesting, and help to identify further which themes, if

any, explored in environmental education seem more likely to produce an action response.

The TEDx feedback forms provided only a snapshot into the students' understanding of the topics discussed. When considering theoretical sensitivity, it was discussed that there are a number of factors, which could have led students to answer the questions in a specific way at a specific time. This approach isn't without merit, as an almost immediate response was collected regarding environmental themes, which is interesting to compare with the reflections of students who have engaged with a topic over a longer period of time. However, such a comparison was not possible within this research due to the cancellation of the Future Food Challenge.

As with all research, had there been a bigger budget for developing the EcoVerse platform, there are many additional features to enhance the interactivity of the platform that would have been pursued, and the EcoVerse team wishes future content to follow a storyline, rather than the variety of slide decks that are currently provided. However, it would be impossible to have the additional interactive content which is aimed for in the future without the initial establishment of the platform that the budget allowed, and the platform as it stands can be used online to facilitate the delivery of the Future Food Challenge.

7.6 Considerations for the future

This chapter has outlined a framework for expanding the EcoVerse EdTech tool beyond its current reach. A major challenge facing EcoVerse in this regard is its programme content moving out of Liverpool. The Future Food Challenge has been created within Liverpool, and students listen to a speaker from Liverpool describe how he has attempted to solve a problem that he was passionate about. It was mentioned in the teacher interviews, that a concern about the programme moving online was that it would lose a special element, which was how the students engaged with Farm Urban's story as a local social enterprise. However, the methodological Framework was designed to address this issue.

Students accessing the Future Food Challenge even within Merseyside will be approaching the project from different backgrounds and with different needs. According to the Methodological Framework, the programme facilitator should always consider the individual and their environment, and whilst many students in Merseyside will benefit from the programme's origins in Liverpool, as witnessed through observations, the programme is still adapted by each facilitator for the needs of their class. It is therefore envisaged that further iterations of the project will build upon the Methodological Framework to aid facilitators in responding to individuals and the environment in which the programme is hosted. This will include resources and templates, which facilitators can use to organise successful collaborations and activities in their local area based on EcoVerse's learning from Farm Urban and Liverpool Life Sciences UTC.

The innovation foundation Nesta highlighted that impact measurement was of great importance to the development of successful EdTech products. As the Future Food Challenge was not completed during 2020, it was not possible to implement all

existing impact measurements, nor trial new methods. Through this research, when impact reporting can recommence, it is recommended that pre and post talk questionnaires are utilised to better understand the response of students to the TEDx talk as well as pre and post programme feedback forms and interviews with students to describe their experience of using EcoVerse's EdTech tool. Similarly, with consent from students, the skill and knowledge tools and the Skills Passports will be analysed to understand how students are able to articulate their skills before and after the programme. The most effective impact measurement tools will be incorporated into future iterations of the EcoVerse platform.

As discussed, the primary future aim for the EcoVerse platform is for the EdTech tool to host many different programmes, like the Future Food Challenge, concerning low carbon technologies. The platform was originally designed to enable organisations, such as Farm Urban, to scale their educational products to reach a wider audience and ease pressure on staff by limiting or removing the need for in person wraparound support. This aim was considered to be necessary for the staff of Farm Urban and their belief in the value of the programme is such that the organisation wants to reach as many students as possible. There was, however, reticence at the thought of less in person interaction after the success of the events such as the launch and competition days, which were enjoyed greatly by Farm Urban staff, students and teachers, as well as other speakers who were invited to the events.

As discussed in the literature review, it has never been so evident as during the COVID-19 global pandemic that meeting in person has immense value and necessity. However, the pandemic has also demonstrated that as circumstances have changed, we have turned to technology to ensure the continued running of our professional and social lives. The literature review also highlighted the inequality in digital literacy and access to technology across the UK that became evident when students were required to be educated from home. As outlined in the methodological framework, it is therefore important that EcoVerse does not shy away from doing whatever is possible to address the socioeconomic inequalities that affect potential programme users' ability to access the EdTech tool and use it to its full capability.

The importance of developing such EdTech tools has become increasingly evident through the pandemic, as the need to have contingency plans for when students cannot attend school has become integral to school activities. Additional schools across Merseyside have contacted Farm Urban about online facilitation of the Future Food Challenge, as schools seek programmes that students can engage with online with their teachers and classmates. The timeline for EcoVerse's product development goals has therefore been shifted forwards as demand has increased. As EcoVerse secures further money for product development, many creative innovations for how to deliver traditionally in person events online will be piloted. It is fortunate that whilst EcoVerse and Farm Urban can continue to explore further content to be hosted on the platform to meet the emerging needs of teachers and students, the EcoVerse EdTech tool has been made fully functional for schools to use.

8. Conclusion

8.1 Environmental Education

This thesis sought to understand the environmental education landscape both at a theoretical level and practically in the context of education in Merseyside. Literature was reviewed to consider both how environmental education is envisioned and implemented.

In exploring a significant amount of the Department for Education's publications, and governmental action before the establishment of the department, it is evident that the trajectory of environmental education in school has changed. Whilst in 2006 the government set a course for sustainable schools by 2020, by 2009 this was not a priority for education. Presently, whilst environmental education is considered in departmental documentation, schools are at liberty to implement sustainable practice and education as they see fit, and will not be monitored or assessed for their efforts. Liverpool City Council has declared a climate emergency, and as part of its 'inclusive growth plan' has indicated its desire to make the city greener. The council considers that this should be in partnership with schools, however has not yet disclosed any clear strategy for moving forward in a joint effort to significantly enhance sustainable practice in schools or promote environmental education.

Teaching unions, teachers and students have expressed their support or commitment to prioritising environmental education, but many teachers have considered that they feel ill equipped or under-resourced to do so. Environmental education is discussed in different community and statutory spaces and increasingly prioritised as a conversation point, yet there is no current coherent and multi-party strategy for delivery.

To gain insight into student responses to environmental education, this thesis has explored the data gathered through an independent evaluation of Farm Urban's Future Food Challenge conducted in 2018, and the feedback forms of 1,204 students who listened to a TEDx talk about sustainable farming in Autumn 2019. Additionally, teachers who facilitated the Future Food Challenge were interviewed and their own understanding of environmental education was explored. The data reiterated the findings of the literature review, and highlighted the resolve of both teachers and students to engage with global environmental issues. Remarkably, students often responded positively to information about food insecurity and suggested how they could enact behaviour change to problem solve. This thesis has suggested that the positive responses can in part be attributed to the fact that information was presented alongside a possible solution, as well as creativity and enthusiasm often being evident in younger people. For this reason, it is integral that young people are equipped to join older generations in seeking solutions to global issues.

8.2 Pedagogical approaches

There are many pedagogical theories and practices relevant to environmental education. There is a significant focus within schools to pass national examinations, the topics for which are established at a state level. The national curriculum discusses issues relating to the environment across many if not most subjects in different ways,

and management and departmental staff have the freedom to choose the means by which they discuss curriculum topics. However, teachers feel that examination questions focus on scientific phenomena for why climate change is occurring rather than engagement with anthropogenic climate change and theoretical, scientific or civic actions, which could address factors relating to climate change.

There has been significant research into the benefits of student participation in scientific research through partnership with industry and universities, which has been seen to enhance the depth of students' understanding of scientific concepts relating to climate change. Such initiatives have demonstrated positive collaborative working, and it has been suggested that such collaboration will be the most successful way of preparing students for solving complex global environmental issues. However, there has been less research exploring why such collaboration is not a predominant pedagogy in science education in schools, and exploring the barriers that need to be addressed to foster such industrial-school relationships.

Farm Urban is in a relatively rare position of co-locating with a school. This has enabled Farm Urban to partner regularly with students and teachers to develop educational content. This partnership ultimately resulted in the Future Food Challenge, which is the first programme to be hosted on EcoVerse's platform. The data explored in this thesis fills a gap in discourse, as it has been identified that there is limited research concerning such industrial-school partnerships in the UK. The successes and challenges that have been explored in this research contribute useful information for schools or industries seeking to increase such partnership working.

Many researchers in education and science have called for a pedagogical shift within the classroom to skills-based learning. This is seen as particularly relevant as many students will be entering employment into jobs that are far removed from traditional industries. It is likely that there will be a high level of automation, meaning that complex problem solving and interpersonal skills will be most required. Many students have developed skills, without an understanding of their transferability, or the ability to articulate a personal skill set. Not only will these students miss out on job opportunities, but also industries will not access the multidisciplinary teams required to solve complex global problems.

For the development of the EcoVerse platform, the various ways in which exploring low carbon technologies through an EdTech programme could also serve to enhance students' skill development were identified. Through this research, opportunities for students to further develop their skills were highlighted, and further resources developed accordingly. EcoVerse has worked with Skillsbuilder Partnership to implement their framework within the Future Food Challenge and support students in learning to develop and articulate their skills.

8.3 Technology

Education Technology is a growing industry seeking to meet the demands of education and innovate new ways of learning inside and outside of schools. The EdTech industry is growing rapidly, however there is concern that EdTech developers are not testing and implementing EdTech design in partnership with teachers and students effectively. Recognising the importance of the use of technology in

education and wishing to be a leader in the field for EdTech industry, in 2019 the government launched an EdTech strategy. The government has outlined its vision for the uses of EdTech; administration; assessment; teaching practice, continuing professional development and lifelong learning. To realise these aims for EdTech the government strategy suggests that the next steps for successful implementation includes training for teachers and the improvement of IT infrastructure.

Other stakeholders in education, such as educational NGOs and teacher unions, welcome the use of EdTech, but similarly wish to instil impact assessment and co-development to ensure that EdTech is implemented successfully, rather than as a tokenistic gesture with no tangible learning outcomes. In addition to the importance of testing, the use of EdTech requires an exploration of the purpose of education. As students have more access to information than ever before with ease, EdTech may mean a shift in education to develop digital literacy with equal importance to literacy and maths, and the adoption of commonly used real world tech tools in the classroom. This could precipitate a move away from traditional forms of assessment, which focuses significantly on the transfer and retention of knowledge, largely through memory.

The use of EdTech has significantly increased in a short space of time due to the outbreak of the global COVID-19 pandemic, which has required students to continue their education at home. Methods for delivery have included online seminars, recorded lessons, and shared online documents for collaboration. There is not yet a clear answer for how the pandemic will effect education long term, but it is likely that it will spur on the development of EdTech tools with renewed vigour.

EcoVerse and Farm Urban originally developed the online platform to reduce the in-person support required from the educational content developers in facilitating the programme. In order to deliver Farm Urban's Future Food Challenge, significant in person support is required by the Farm Urban team in order for the project to run. By using the EcoVerse platform to move more content online and reduce the time required by Farm Urban staff, the Future Food Challenge is scalable, as it can have a wider geographical reach and therefore be accessed by more schools. This fulfils the primary mission of EcoVerse, as it seeks to make environmental education, and specifically knowledge about low carbon technologies available to a large audience through its EdTech tool with the hope of precipitating further innovation in low carbon initiatives by users.

EcoVerse's approach now serves a dual purpose in making low carbon technologies available to more students, but additionally providing a high quality EdTech tool which can be of use for teachers adjusting to educating their students remotely as a result of the pandemic. In the interviews conducted, some teachers commented that they had been familiarised with technology through the Future Food Challenge, such as Zoom, which has now become an integral part of education during the pandemic. This has reiterated the importance of EcoVerse's approach to enhance digital literacy.

The EdTech tool is a user-friendly online platform, hosting educational content about low carbon technology, with individual logins for students to access resources and empowering students to take responsibility for their own learning. In addition to the platform itself, EcoVerse has also highlighted other opportunities for students to

enhance their digital literacy, for instance, by adopting commonly used business tools such as Asana or Slack for their own project management. Through these efforts, it is the aim of EcoVerse to ensure that technology is used within sessions in a coherent and natural way to enable students to utilise the project to its greatest extent. Whilst this was originally planned to support students in their future digital participation, the benefits of this approach were demonstrated sooner than expected, as users felt confident to use digital tools when they became a necessity due to the pandemic, having utilised them already during the Future Food Challenge.

There are both external and internal barriers to the use of EdTech by educators and students. External barriers can include physical barriers to the use of technology, such as poor Internet connectivity or a lack of access to devices. Internal barriers can include poor previous experience of technology use, an ambivalence towards its use compared to tried and tested pedagogy, and a fear that the importance of human connection will be subsumed by the use of technology. The pandemic has exposed the significant external barriers, which exist in the UK, particularly along socioeconomic divides. However, whilst many people have been forced to engage with EdTech to a greater extent than ever before, never has it been so obvious that physical human interaction and shared spaces are instrumental to our physical and psychological health, which EdTech cannot address.

There are ethical issues to be explored as EdTech rapidly develops. Technology has demonstrated that legal frameworks struggle to keep pace to safeguard against the darker uses of technology. Large EdTech applications can gather big data, with unintended, or indeed intended, negative outcomes. The use of big data for personalised learning could result in algorithmic bias, as outcomes for social groups could reinforce stereotypes when predicting the needs and wants of a community. Additionally, whilst EdTech can be used to disseminate knowledge about the climate crisis, increase industrial-school collaboration, and facilitate the development of real world scientific skills, technology in itself is a large environmental burden. Whilst EcoVerse utilises existing IT infrastructure, and data gathering is facilitated through schools, EcoVerse's future iterations must ensure a commitment to engaging with the ethical issues around EdTech.

It would be advisable for EcoVerse to explore the development of a programme specifically relating to the carbon cost of technology use, to ensure that the use of existing IT infrastructure serves to innovate solutions to environmental harm from technology. EcoVerse must ensure that it does not blindly answer the call for increased use of EdTech without understanding the external and internal barriers to its use, and questioning its own motives as to why EdTech is important for the provision of education for future generations. Consideration must be taken of ways to mitigate the environmental impact of our use of technology.

8.4 Inclusivity

Facilitating increased environmental education through EdTech requires a holistic approach, ensuring dialogue between different communities, disciplines and stakeholders. It is not enough to insist upon an increase of environmental education without first understanding the various social structures at play which construct our unsustainable lifestyles.

There are various third party resources of a high quality for teachers to access for the exploration of environmental education using different pedagogies in the classroom. Third party efforts, such as the international Eco School framework aid schools in enhancing environmental education and sustainable practice in their schools. However, values, beliefs and motivations all interact with decisions to use such resources at all when planning lessons, and there are additional barriers to implementing environmental education. For example, there is much socioeconomic disparity in the UK education system, and whilst teachers and schools are using their budgets to mitigate the manifestations of child poverty for their students, it is unlikely that resources will be used to address the existential, yet not obviously immediate in the UK, threat of climate change.

Students' learning experience is more than what they experience in the classroom alone. Part of a student's subliminal learning is what they see around them daily, from their physical environment to the way that behaviour is modelled. Learning is also shaped by who is seen in what spaces, for example, the background, class, ethnicity or gender of educators or scientists. Environmental education is equally about what leaders and role models choose to prioritise, and where students see the representation of their own community. To engender an holistic environmental education, many different actors are required to ensure intersectional viewpoints from across different disciplines.

EcoVerse have made efforts to increase the accessibility of the platform, such as partnership with an SEN school, hosting a 'meet the scientist' session for students and developing educational content through the different lenses of multi-disciplinary team members. However, EcoVerse is still in its early stages as it considers the accessibility of the platform, and must ensure the development of effective partnership working to engage with the socioeconomic inequalities that prevent students from being able to use the EdTech tool, or participate in pro-environmental spaces.

8.5 Summary

This research sought to explore whether an EdTech tool could be used to aid the building of a low carbon future. Through the research, the first iteration of the EcoVerse EdTech tool, which is a platform to host educational content about low carbon technologies, was developed. The research also, as an unanticipated outcome, resulted in the development of many further resources, which are now hosted on the EcoVerse platform (see appendices 9 and 10). This research has met the requirements of the project brief:

- 1) Feedback from the independent evaluation was used to evaluate the prototype EdTech Product.
- 2) The principles underpinning the successes of the Future Food Challenge were identified and replicated in further resource development.
- 3) The landscape for education and EdTech were explored to provide context for the development of the EcoVerse platform to ensure that best practice was replicated and solutions for challenges were innovated.

- 4) Unique data was gathered which has contributed not only to the development of the EcoVerse platform, but can contribute to a wider narrative around environmental education, for which there is currently limited research.
- 5) The first iteration of the EcoVerse online platform was completed, and can be used as a fully online programme.
- 6) Theoretical and methodological frameworks were developed to establish how educational content for other low carbon technologies can be hosted on the platform, and how the programmes can be adapted for alternate audiences.

It was outlined in chapter 4 that due to the outbreak of the COVID-19 pandemic the data collection could not take place as anticipated. An alternative dataset was therefore used that had previously been excluded due to time constraints. The subsequent inclusion of this dataset of 1,204 feedback forms from Merseyside students resulted in a shift in emphasis of the thesis to incorporate a wider consideration of student response to environmental education as well as the facilitation of environmental education through EdTech.

Whilst the title of the thesis remained unchanged, as this summarised the ultimate aim of the research, the use of the TEDx talk feedback brought an unanticipated but welcome angle to the product development. The data was analysed and the concepts of reflective or action responses were explored. In conjunction with the findings of the literature review, these concepts informed the development of a theoretical framework to understand the conditions required for students to be motivated to take action in the form of pro-environmental behaviour. The shift in emphasis to incorporate a focus on environmental education as well as EdTech has resulted in a more robust end product, with a methodological framework for further development.

This thesis has identified areas for future research and development, to understand further how an EdTech tool can facilitate a pro-environmental action response to build a low carbon future. The EdTech tool produced through this research has provided a product through which the Future Food Challenge can be delivered online, and future impact assessment will be completed to establish the utility of the EdTech tool in building a low carbon future. It is envisaged that a coherent way of identifying the success of the product in this regard is to complete a longitudinal study with project participants to understand if there is a significant difference in the pro-environmental behaviour of those who undertook the programme compared to those who did not. Pro-environmental behaviour may range from increased recycling or the consumption of sustainably grown food to the pursuit of career choices that aim to innovate solutions to global environmental issues. It would not be possible to enact impact assessment of this nature in the future without the development of the EdTech tool that has been the focus of this thesis.

Bibliography

Allen, P., Blake, L., Harper, P., Hooker-Stroud, A., James, P. and Kellner, T. (2013) *Zero Carbon Britain: Rethinking the future*, Aberystwyth: CAT Publications, pp. 1-26.

Arrhenius, S., (1896), 'On the Influence of Carbonic Acid in the Air upon the Temperature of the Ground', *Philosophical Magazine and Journal of Science*, 41(5), pp. 237-276.

Ayuningtyas, L., Djatmika, E., Wardana, L., (2015), 'Hard and soft skills enhancement in entrepreneurship learning for the twelfth grade students of SMK Kartika, IV-1 Malang', *Journal of Education and Practice*, 6(29), pp. 188-194.

Bahçivan, E., Güneş E., Üstündağ, M., (2018) 'A comprehensive model covering prospective teachers' technology use: the relationships among self, teaching and learning conceptions and attitudes', *Technology, Pedagogy and Education*, 27(4), pp. 399-416.

Banerjee, C., (2014), 'Up, Up and Away! The Economics of Vertical Farming', *Journal of Agricultural Studies*, 2(1), pp. 40-60.

Banerjee, P., (2017), 'Is informal education the answer to increasing and widening participation in STEM education?', *Review of Education*, 5(2), pp. 202-224.

Bates, O., Hazas, M., Friday, A., Morley, J., and Clear, A., (2014) 'Towards an holistic view of the energy and environmental impacts of domestic media and IT', *Human Factors in Computing Systems*, pp. 1173-1182.

Batty, R., Sharples, M., Florescu, A., Wong, A., (2019) 'EdTech testbeds: models for improving evidence', Nesta, available at: <https://www.nesta.org.uk/report/edtech-testbeds/>, accessed on 3 September 2020.

BBC (2017), 'Textbook spends drop 30% in Essex secondary schools', *BBC News*, 17 June 2017.

BBC (2019), 'Meet Liverpool's UK Youth Parliament Member Eva Carroll', *BBC News*, 21 November 2019.

BBC News (2019), 'UK Parliament declares climate change emergency', available at: <https://www.bbc.co.uk/news/uk-politics-48126677> (accessed on 3 July 2020).

Benke, K., and Tomkins, B., (2018) 'Future food-production systems: vertical farming and controlled environment agriculture', *Sustainability: science, practice and policy*, 13(1), pp. 13-26.

Birney, A., Kellard, B., Reed, J., 'The journey of sustainable schools: developing and embedding sustainability', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/339991/the-journey-of-sustainable-schools-developing-and-embedding-sustainability.pdf, accessed on 9 August 2020.

Blau, I and Hameiri, M., (2017), 'Ubiquitous mobile educational data management by teachers, students and parents: Does technology change school-family communication and parental involvement?', *Education and Information Technologies*, 22(3), pp. 1-17.

Boland, H., (2020) 'The children left behind as schools go digital', *The Telegraph Online*, 6 May 2020.

Book Widgets (2020), '10 EdTech apps teachers should use in the 2020 classroom', available at: <https://www.bookwidgets.com/blog/2020/01/10-edtech-apps-teachers-should-use-in-the-2020-classroom-bett-inspiration>, accessed 1 September 2020.

Boulianne, S., Lalancette, M., Ilkiw, D. 'School Strike 4 Climate: Social Media and the International Youth Protest on Climate Change' *Media and Communication*, 8(2), pp. 208-218.

Bristol City Council (2018), 'Bristol City Council Mayor's Climate Emergency Action Plan 2019', available at: <https://www.bristol.gov.uk/documents/20182/33379/Mayor%27s+Climate+Emergency+Action+Plan+2019+FINAL> (accessed on 5 July 2020).

British Youth Council, (2019), available at: <https://www.byc.org.uk/news/2019/uk-youth-parliament-launch-action-against-knife-crime>, accessed on 9 August 2020.

Bulut, B., and Karasakaloğlu, N., (2018), 'Digital Reading Disposition Scale: A Study of Validity and Reliability', *Universal Journal of Educational Research* 6(4) pp. 613-618.

Bush, D., Sieber, R., Seiler, G., Chandler, M., Chmura, G., (2019) 'Bringing climate scientist's tools into classrooms to improve conceptual understandings' *Journal of Environmental Studies and Sciences* 9(1), pp. 25 - 34.

A. Bryman, *Social Research Methods*, Fourth Edition, (2012), *Oxford University Press*

Canberra ANU: Press 2013.

Carlisle, L.,, Montenegro de Wilt, M., DeLonge, M., Iles, A., Calo, A., Getz, C., Ory, J., Munden-Dixon, K., Galt, R., Melone, B., Knox, R. and Press, D., (2019), 'Transitioning to Sustainable Agriculture Requires Growing and Sustaining an Ecologically Skilled Workforce', *Frontiers in Sustainable Food Systems*, <https://doi.org/10.3389/fsufs.2019.00096>

Chao, Q. and Feng, A., (2018) 'Scientific Basis of Climate Change and its response', *Global Energy Interconnection*, 1(4), pp. 420-427.

Clarke, L., and Agyemen J., 'Is there more to environmental participation than meets the eye? Understanding agency, empowerment and disempowerment among black and minority ethnic communities' *Area*, 43(1), pp. 88-94.

Climate Emergency Declaration (2020), 'Climate emergency declarations in 1,737 jurisdictions and local governments cover 820 million citizens', available at: <https://climateemergencydeclaration.org/climate-emergency-declarations-cover-15-million-citizens/>, (accessed on 4 July 2020).

Datta, Y. (2010) 'Maslow's hierarchy of basic needs: an ecological view' *Oxford Journal* Vol. 9 (1), pp. 39-57. Department for Business, Energy and Industrial Strategy (2017), 'Industrial Strategy: building a Britain fit for the future', available at: <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>, accessed on 12 August 2020.

Department for Business, Energy and Industrial Strategy (2017), 'Industrial Strategy: building a Britain fit for the future', available at: <https://www.gov.uk/government/publications/industrial-strategy-building-a-britain-fit-for-the-future>, accessed on 12 August 2020.

Department of business, energy and industrial strategy, (2019), 'Green collar jobs in offshore wind set to triple by 2030', available at: <https://www.gov.uk/government/news/green-collar-jobs-in-offshore-wind-set-to-triple-by-2030>, accessed on 3 September 2020.

Department for Education (2019), 'Realising the Potential of Technology in Education: a strategy for education providers and the technology industry', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/791931/DfE-Education_Technology_Strategy.pdf, (accessed on 3 September 2019)

Department for Education (2012) 'Top Tips for Sustainability in Schools', available at <https://www.gov.uk/government/publications/top-tips-for-sustainability-in-schools>, accessed on: 12 June 2020.

Department for Education (2013), 'The National Curriculum: Overview' (Series: National Curriculum), available at <https://www.gov.uk/national-curriculum>, accessed on 2 July 2020.

Department for Education (2014), 'P-Scales: Attainment Targets for Pupils with SEN', available at <https://www.gov.uk/government/publications/p-scales-attainment-targets-for-pupils-with-sen>, accessed on 14 June 2020.

Department for Education (2015), 'Keeping children safe in education' available at: <https://www.gov.uk/government/publications/keeping-children-safe-in-education--2>, accessed on 10 August 2020.

Department for Education (2018), 'Mental Health and Behaviour in Schools', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/755135/Mental_health_and_behaviour_in_schools_.pdf, accessed on 2 August 2020.

Department for Education (2019), 'Department for Education Single Departmental Plan', available at <https://www.gov.uk/government/publications/department-for-education-single-departmental-plan/department-for-education-single-departmental-plan--2>, accessed on: 3 June 2020.

Department for Education (2019) 'Press release: EdTech Strategy marks 'new era' for schools', available at: <https://www.gov.uk/government/news/edtech-strategy-marks-new-era-for-schools#:~:text=The%20Government's%20EdTech%20strategy%20highlights,produces%20great%20outcomes%20for%20pupils.>, accessed on 2 August 2020.

Department for Education (2019), 'Industry Placements', available at: <https://www.gov.uk/guidance/industry-placements>, accessed on 9 August 2020.

Department for Education (2019), 'Realising the potential of technology in education', available at: <https://www.gov.uk/government/publications/realising-the-potential-of-technology-in-education>, accessed on 10 August 2020.

Department for Education (2020), 'Get help with technology during coronavirus (COVID-19)', available at: <https://www.gov.uk/guidance/get-help-with-technology-for-remote-education-during-coronavirus-covid-19>, accessed 6 September 2020.

Department for Energy and Climate Change (2015), 'UK progress towards GHG emission reduction targets', available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/414241/20150319_Progress_to_emissions_reductions_targets_final.pdf, (accessed on 25 April 2020).

Derbel, F. (2017). 'Technology-Capable Teachers Transitioning to Technology-Challenged Schools'. *Electronic Journal of e-Learning*. 15(269), pp. 269-280.

Eco Schools (2020) available at: <https://www.eco-schools.org.uk/>, accessed on 9 August 2020.

Edutopia (2020), '12 Awesome EdTech apps', available at: <https://www.edutopia.org/blog/12-awesome-edtech-apps-vicki-davis>, accessed on 1 September 2020.

Eriksson, H., Högdin, S., Isaksson A., (2018) 'Education and Career Choices: How the School Can Support Young People to Develop Knowledge and Decision-making Skills', *Universal Journal of Educational Research* 6(9), pp. 1900 - 1908.

European Commission, (2015), 'Science education for responsible citizenship', available at: https://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf, accessed on 9 August 2020.

European Commission, (2020) 'Paris Agreement', available at: https://ec.europa.eu/clima/policies/international/negotiations/paris_en, (accessed on 3 July 2020)

Farm Urban (2014), available at <https://farmurban.co.uk/the-worlds-first-aquaponic-double-helix/>, accessed (13 September 2019)

Farm Urban (2020), available at <https://farmurban.co.uk/about/>, (accessed on 10 September 2019)

Farm Urban (2020), available at <https://farmurban.co.uk/workshops/>, (accessed 3 July 2020)

Farm Urban, (2020), 'Greens for Good', available at <https://www.greensforgood.co.uk/>, accessed on 6 September 2020.

Fouquet, R., (2014) 'Long-Run Demand for Energy Services: Income and Price Elasticities over Two Hundred Years', *Review of Environmental Economics & Policy*. 8(2), pp. 186-207.

Franzen, R., (2018), 'Environmental education in teacher education programs: Incorporation and use of professional guidelines', *The Journal of Sustainability Education*, Volume 16, pp. 1-18.

Fuller, C., (2020) 'Education Innovation Clusters: Supporting transformative teaching and learning', *Childhood Education*, 96(1), pp. 34-47.

Fujitsu (2018), 'Research Report: UK, the road to digital learning', available at: <https://www.birmingham.ac.uk/Documents/HEFI/FUJ-Education-Report-UK.pdf>, accessed on 11 August 2020.

GCSE Guide (2020), 'AQA GCSE science past papers', available at: <https://gcseguide.co.uk/papers/aqa/science/>, accessed on 1 September 2020.

General Teaching Council for England, (2011), *Creating a curriculum for learning: Research for Teachers anthology 4*, available at: http://webcache.googleusercontent.com/search?q=cache:wBg2SO8VFcAJ:dera.ioe.ac.uk/10000/1/creating_a_curriculum+&cd=9&hl=en&ct=clnk&gl=uk, accessed on 8 August 2020.

Ghag, J., 'A ticking time bomb? Liverpool declares a climate emergency: What next?' (2019), *Environmental Law Review*, 21(3) pp. 169-171.

Grimley M., and Banner, G., (2008), 'Working memory, cognitive style, and behavioural predictors of GCSE exam success', *Educational Psychology*, 28(3), pp. 341-351.

Harris, N., (2012) 'Local Authorities and the Accountability Gap in a Fragmenting Schools System' *The Modern Law Review* 75(4) pp. 511 - 546.

Haydn, T. and Harris, R. (2012) 'What happens to a subject in a 'free market' curriculum? A study of secondary school history in the UK' *Research Papers in Education*, 27 (1) pp. 81-101.

Hicks, D., (2020) 'Teaching for a Better World' available at: <https://www.teaching4abetterworld.co.uk/sustainable.html>, accessed on 2 June 2020.

Hill, D., Lewis, C. and Yarker, P, 'Conservative Education Reloaded: Policy, Ideology and Impacts in England', *Journal for Critical Education Policy Studies*. 14(3), pp. 1-42.

Hook, L, (2019), 'Greta Thunberg "all my life I've been the invisible girl"', *The Financial Times*, 22 February 2019.

Huckle, J., (2009) 'Sustainable schools: responding to new challenges and opportunities' *Geography*, 94, (1), pp. 13-21.

Institute for Fiscal Studies, '2019 Annual Report on Education Spending in England', available at <https://www.ifs.org.uk/publications/14369>, accessed on 10 August 2020.

International Institute for Sustainable Development, (2013), 'A brief history of the UNFCCC and the Kyoto Protocol', *Earth Negotiations Bulletin*, 12(580), pp. 1-3.

Jackson, T., (2013) *Building a Sustainable and Desirable Economy-in-Society-in-Nature*

Jacob, B., Berger, D., Hart, C., and Loeb, S., (2016) 'Can Technology Help Promote Equality of Educational Opportunities?' *RSF: The Russell Sage Foundation Journal of the Social Sciences*, 2(5), pp. 242-271.

Jagannathan, S., Ra, S., Maclean R., (2019) 'Dominant recent trends impacting on jobs and labor markets - An Overview', *International Journal of Training Research*, 17(1), pp. 1-11.

Jickling, B. and Sterling, S. (2017) *Post-sustainability and Environmental Education: Remaking Education for the Future*, Palgrave Macmillan, DOI 10.1007/978-3-319-51322-5_1.

Jones, K., and Tymms, P., (2014), 'Ofsted's role in promoting school improvement: the mechanisms of the school inspection system in England' *Oxford review of education*, 40(3), pp. 315-330

Joyce, A., Goddek, S., Kotzen, B. and Wuertz, S., (2019) 'Aquaponics: Closing the cycle on limited water, land and nutrient resources' *Aquaponics Food Production Systems : Combined Aquaculture and Hydroponic Production Technologies for the Future* (Springer International Publishing), 2019. Pp. 19-34.

Jung, J., Petkanic, P., Nan, D., Kim, J. (2020), 'When a girl awakened the world: A user and social message analysis of greta thunberg' *Sustainability* 12 (7), pp. 1-17.

Kalantari, F., Tahir, O., Joni, R., Fatemi, E., (2018) 'Opportunities and challenges in sustainability of vertical farming: a review', *Journal of Landscape Ecology*. 11(1) pp. 35-60.

Kaushik, A. (2004) *Perspectives in Environmental Studies*, New Delhi: New Age International (P) Ltd.

Kelly, D., (2015) 'Overcoming Barriers to Classroom Technology Integration' *Educational Technology*, 55(2), pp. 40-43.

Kerr, K., (2020) 'Teacher development through co teaching outdoor science and environmental education across the elementary-middle school transition', *The Journal of Environmental Education*, 51(1), pp. 29-43.

Kotiranta, A., Tahvanainen, A., Kovalainen, A., Poutanen, S., (2020) 'Forms and varieties of research and industry collaboration across disciplines', *Heliyon*, 6(3), pp. 1-18.

Kyaw, T. Y. and Ng, A. K. (2017) 'Smart Aquaponics System for Urban Farming', *Energy Procedia*. 143, pp. 342-347.

Lavanya, R. and Jutta, B., (2017) 'The Legality of Downgrading Nationally Determined Contributions under the Paris Agreement: Lessons from the US Disengagement', *Journal of Environmental Law*, 29(3), pp. 537-551.

Life Changes Trust (2020), 'Action Research' available at <http://www.lctevaluationtoolkit.com/action-research>, accessed on 1 September 2020.

Lin-Siegler, X., Ahn, J., Chen, J., (2016), 'Even Einstein Struggled: Effects of Learning About Great Scientists' Struggles on High School Students' Motivation to Learn Science', *Journal of Educational Psychology* 108(3), pp. 314 –328.

Liverpool City Council (2018), 'Inclusive Growth Plan', available at <https://liverpool.gov.uk/media/1356877/mayoral-growth-may-2018-a3-spreads.pdf>, accessed on 15 June 2020.

Liverpool City Council, 'Agenda item: Declaring a Climate Change Emergency by Mayor Joe Anderson, OBE, Councillor Richard Kemp CBE, Councillor Tom Crone and Councillor Steve Radford', available at: <http://councillors.liverpool.gov.uk/mgAi.aspx?ID=137679> (accessed on 23 April 2020)

Liverpool City Council (2019), 'Indices of deprivation', available at: <https://liverpool.gov.uk/council/key-statistics-and-data/indices-of-deprivation/>, accessed on 15 August 2020.

Liverpool City Region Local Enterprise Partnership (2020), available at: <https://www.liverpoollep.org/growth-sectors/low-carbon/>, accessed 15 August 2020.

Liverpool City Region Brussels Office, (2017), available at: <https://www.liverpoollep.org/wp-content/uploads/2015/06/Building-Climate-Resilience-in-Liverpool-City-Region-FINAL2017.pdf>, accessed on 15 August 2020.

Liverpool Life Science UTC (2020), available at <https://lifesciencesutc.co.uk/what-we-do/extra-curricular-and-enrichment/>, (accessed on 3 July 2020)

Magaji, A., Ade-Ojo, G., Betteney, M. (2018) 'Towards a pedagogy of science teaching: an exploration of the impact of students-led questioning and feedback on the attainment of Key Stage 3 Science students in a UK school, *International Journal of Science Education*, 40(9), pp. 1076-1093.

Mayor of Liverpool (2018), 'Inclusive Growth Plan', available at: <https://liverpool.gov.uk/media/1356877/mayoral-growth-may-2018-a3-spreads.pdf>, (accessed on 23 April 2020).

McPherson, A., (2012) 'Let Them Eat Carbon: The End of the Kyoto Protocol', *Georgia Journal of International and Comparative Law*, 41(1), pp. 219-250.

Mertens, D. and Hesse-Biber, S., (2012) 'Triangulation and Mixed Methods Research : Provocative Positions ', *Journal of Mixed Methods Research*, 6(2).
Merritt, E., Hale, A., Archambault, L., (2019) 'Changes in Pre-Service Teachers' Values, Sense of Agency, Motivation and Consumption Practices: A Case Study of an Education for Sustainability Course Eileen Merritt' *Sustainability*, 11(155), doi:10.3390/su11010155.

Miller, B., (2017), 'Navigating STEM: Afro Caribbean Women Overcoming Barriers of Gender and Race', *Sage Open*, Volume 7, pp. 1-14.

MOOC, (2020), 'About MOOCs' available at: <https://www.mooc.org/>, accessed on 1 September 2020.

Morrison, C., (2018), 'More than 1 million children's education at risk due to poor broadband access, finds study', *Independent*, 27 March 2018.

Mulholland, R., McKinlay, A., Sproule, J., (2017), 'Teachers in need of space: the content and changing context of work', *Educational Review*, 69(2), pp. 181–200.

NAHT, (2019), 'Global Action Plan: Take part in Their New Towards Clean Air Classrooms Programme', available at <https://www.naht.org.uk/news-and-opinion/news/curriculum-and-assessment-news/global-action-plan-take-part-in-their-new-towards-clean-air-classrooms-programme/>, accessed 15 June 2020.

NAHT, (2020), 'Curriculum and Assessment', available at <https://www.naht.org.uk/our-priorities/curriculum-and-assessment/>, accessed 15 June 2020.

NAHT (2020), 'Join the Eco-Schools Programme and Engage Your School and Wider Community in Environmental Projects', available at <https://www.naht.org.uk/news-and-opinion/news/curriculum-and-assessment-news/join-the-eco-schools-programme-and-engage-your-school-and-wider-community-in-environmental-projects/>, accessed on 16 June 2020.

National Association for Environmental Education, (2015), The Environmental Curriculum, available at https://naee.org.uk/wp-content/uploads/2015/06/NAEE_The_Environmental_Curriculum.pdf, accessed on 8 August 2020.

Navarro, D., Kodama, G., dos Santos, M., Nogueira de Souza, A., Crispim Hundley, G., (2020) 'Analysis of the financial viability of the aquaponics (fish farming and hydroponics) system using the Monte Carlo method', *Revista Brasileira de Agropecuária Sustentável*, 9(4), pp. 20-26.

Nesta (2019), 'EdTech companies called on to tackle challenges facing the education system', available at <https://www.nesta.org.uk/press-release/edtech-companies-called-tackle-challenges-facing-education-system/>, (accessed on 3 July 2020)

Nesta (2019), 'Testing innovation in the real world', available at <https://www.nesta.org.uk/report/testing-innovation-real-world/>, (accessed 3 July 2020)

Nesta (2019) 'Making the most of technology in education', available at: https://media.nesta.org.uk/documents/Making_the_Most_of_Technology_in_Education_03-07-19.pdf, accessed on 5 August 2020.

Nesta (2019), 'Schools and colleges in England: Join the EdTech Innovation Testbed!', available at: <https://www.nesta.org.uk/project/edtech-innovation-testbed/schools-colleges/>, accessed on 12 August 2020.

NEU and CPAG (2018), 'Child Poverty and education: a survey of the experiences of NEU members', available at: <https://cpag.org.uk/policy-and-campaigns/report/child-poverty-and-education-survey-experiences-neu-members#:~:text=Child%20poverty%20and%20education%3A%20A%20survey%20of%20the%20experiences%20of%20NEU%20members,-Report&text=60%25%20of%20respondents%20think%20that,think%20it%20has%20worsened%20significantly.>, accessed on 10 August 2020.

NEU (2020), 'EPI on Technical Education', available at <https://neu.org.uk/press-releases/epi-technical-education>, accessed on 6 August 2020.

NEU (2020), 'Why Join' available at <https://neu.org.uk/why-join>, accessed on 15 June 2020.

NEU (2020), 'NEU joins civil society groups in demanding social and environmental protection', available at <https://neu.org.uk/press-releases/neu-joins-civil-society-groups-demanding-social-and-environmental-protection>, accessed on June 15 2020.

NEU (2020) 'NEU Annual Conference 2020, Bournemouth, Conference Motions' available at: <https://neu.org.uk/media/8896/view>, accessed on 15 June 2020.

North Liverpool Academy, (2020), available at <https://northliverpoolacademy.co.uk/gems-2/>, accessed on 9 August 2020.

North, P., (2010), 'Unsustainable urbanism? Cities, climate change and resource depletion: a Liverpool case study', *Geography Compass*, 4(9), pp. 1377 – 1391.

O'Brien, K., (2018) 'Cities - Good for the environment?' *International Journal of Environmental Studies*, 75(1), pp. 16–28.

OECD (2015), *Students, Computers and Learning: Making the Connection*, (PISA, OECD Publishing). Available at: <http://dx.doi.org/10.1787/9789264239555-en>

Ofsted, (2008), 'Schools and Sustainability: A Climate for Change?', available at: <http://esd.escalate.ac.uk/downloads/1768.pdf>, accessed on 2 June 2020.

Ofsted, (2019), 'The Education Inspection Framework', available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/801429/Education_inspection_framework.pdf, accessed on 2 June 2020.

Ojala, M., (2018-9), 'Eco Anxiety', *Royal Society for the Encouragement of Arts, Manufactures and Commerce*, 164(4), pp. 10-15.

Outhwaite, L., (2017) 'Closing the gap: Efficacy of a tablet intervention to support the development of early mathematical skills in UK primary school children' *Computers & Education*, Volume 108, pp. 43 – 59.

Owen, J., (2017) 'Education must transform to make people ready for AI', *Financial Times*, available at <https://www.ft.com/content/ab5daa64-d100-11e7-947e-flea5435bcc7>, accessed on 31 July 2020.

Pasten, C. and Santamarina, J., (2012) 'Energy and Quality of Life' In *Special Section: Fuel Poverty Comes of Age: Commemorating 21 Years of Research and Policy*, *Energy Policy*. 49 pp. 468-476.

Price, M., and Wright, L., (2019) 'Liverpool teenagers 'paid money to stab other youths'', *BBC News*, 17 June 2019.

Razon, L., (2014) 'Life cycle analysis of an alternative to the haber-bosch process: Non-renewable energy usage and global warming potential of liquid ammonia from cyanobacteria' *Environmental Progress & Sustainable Energy*, 33(2), pp. 618-624.

Roberts, S., (2008) 'Energy, Equity and the Future of the Fuel Poor' *Foresight, Sustainable Energy Management and the Built Environment Project*, *Energy Policy*. 36(12): pp. 4471-4474.

Rusten, G., Hermelin, B., 'Cross-sector collaboration in upper secondary school vocational education: experiences from two industrial towns in Sweden and Norway', *Journal of Education and Work*, 30(8), pp. 813-826.

Scalise, K., (2016) 'Student collaboration and school educational technology: Technology integration practices in the classroom', *Journal on School Educational Technology*, 11(4) pp. 53-63.

Science Business Innovation Board (2012), 'Making Industry-University Partnerships Work', available at: https://www.praxisauril.org.uk/sites/praxisunico.org.uk/files/Making-industry-university-partnerships-work_EU.pdf, accessed on 9 August 2020.

Selwyn, N., (2019) 'EdTech is killing us all: facing up to the environmental consequences of digital education', available at: <https://lens.monash.edu/@education/2018/10/25/1363185/edtech-is-killing-us-all>, accessed on 5 August 2020.

Simms, W., (2020) 'Bringing environmental identity research into the classroom context: examining the theoretical foundations influencing its current use in the literature', *Studies in Science Education*, 56(1), pp. 35-76.

Skillsbuilder Partnership (2020) available at: <https://www.skillsbuilder.org/>, accessed on 30 July 2020.

Smith, P. Price, J., Molotoks, A., Warren, R. and Malhi, Y. (2018) 'Impacts on terrestrial biodiversity of moving from a 2°C to a 1.5°C target'. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 376(2119), pp. 1 -18

Somekh, B., (2006), *Action Research a methodology for change and development*, (Open University Press), accessed through the University of Liverpool Catalogue, pp. 1- 226.

Spring, C., Adams, M., Hardman, M., (2019) 'Sites of learning: Exploring political ecologies and visceral pedagogies of surplus food redistribution in the UK' *Policy Futures in Education*, 17(7) pp. 844–861.

Stavins, R., J. Zou, T. Brewer, M. Conte Grand, M. den Elzen, M. Finus, J. Gupta, N. Höhne, M.-K. Lee, A. Michaelowa, M. Paterson, K. Ramakrishna, G. Wen, J. Wiener, and H. Winkler, (2014) 'International Cooperation: Agreements and Instruments'. *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge: Cambridge University Press, pp. 1001 - 1082.

Sterling S. (2017) Assuming the Future: Repurposing Education in a Volatile Age. In: Jickling B., Sterling S. (eds) Post-Sustainability and Environmental Education. Palgrave Studies in Education and the Environment. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-51322-5_3

Students Organising for Sustainability UK (2020) 'Our Research', available at: <https://sustainability.nus.org.uk/our-research/our-research-reports/schools-and-sustainability/school-sustainability-survey>, accessed on 17 June 2020.

Students Organising for Sustainability UK (2020) 'Teachers and Climate Change Education', available at: <https://sustainability.nus.org.uk/our-research/our-research-reports/schools-and-sustainability/teachers-climate-change>, accessed on 17 June 2020.

Tait, A. (2018) 'Open Universities: the next phase' Asian Association of Open Universities Journal, 13(1), pp. 13-23.

Tan, E., and So, H., (2019) 'Role of environmental interaction in interdisciplinary thinking: from knowledge resources perspectives', The Journal of Environmental Education, 50(2), pp. 113-130,

Tapia, R., (2019) 'The precious few' must press for change: Underrepresented minorities in STEM need others like them as leaders and role models' ASEE Prism, 29(2), pp. 52-52.

Taylor, I., and Widdas, E., (2018), 'Expanding the Farm Urban Initiative: evaluation report no. 1', made available by Farm Urban for the purposes of this research, pp. 1-14

Taylor, I., and Widdas, E., (2018), 'Farm Urban Future Food Challenge: Evaluation report no. 5' made available by Farm Urban for the purposes of this research, pp. 1 – 54.

Taylor, I., and Widdas, E., (2018), 'Farm Urban Future Food Challenge: Evaluation report no. 6' made available by Farm Urban for the purposes of this research, pp. 1 – 42.

Taylor, I., and Widdas, E., (2018), 'Farm Urban Future Food Challenge: Evaluation report no. 7' made available by Farm Urban for the purposes of this research, pp. 1 – 54

Taylor, I., and Widdas, E., (2018), 'The Future Food Challenge: Teacher's welcome day evaluation report' made available by Farm Urban for the purposes of this research, pp. 1 – 33

Taylor, I., and Widdas, E., (2018), 'The Future Food Challenge: Launch Day participant perceptions', made available by Farm Urban for the purposes of this research, pp. 1 – 43.

Teach the Future, (2020) 'Asks', available at:
<https://www.teachthefuture.uk/hub/44e33423-98c7-4882-9e7f-81c8fd450722>,
accessed on 2 July 2020.

TES (2019), 'Exclusive: 63% of schools extend GCSEs into key stage 3', available at:
<https://www.tes.com/news/exclusive-63-schools-extend-gcses-key-stage-3>, accessed
on 8 August 2020.

TES (2020), 'Celebrating Earth Day in the classroom', available at:
<https://www.tes.com/teaching-resources/blog/celebrating-earth-day-classroom>,
accessed on 9 August 2020.

Taylor, M., (2019) 'Teachers want climate crisis training, poll shows', *The Guardian*,
21 June 2019.

Thomasson Goodwin, J., Goh, J., Verkoeyen, S., Lithgow, K., 'Can students be taught
to articulate employability skills?', *Education and Training* 61(4), pp. 445-460.

Thunberg, G., (2019), 'Our house is on fire': Greta Thunberg, 16, urges leaders to act
on climate' *The Guardian*, 25 January 2019.

Tomlinson, L. (2015), 'Indoor aquaponics in abandoned buildings: a potential
solution to food deserts' *Sustainable Development Law & Policy*, 16(1), pp. 16-40.

UK Government (2020), 'Climate Change Act 2008', available at:
<http://www.legislation.gov.uk/ukpga/2008/27/part/1/crossheading/the-target-for-2050>,
(accessed on 5 July 2020).

UK Student Climate Network (2020), available at: <https://ukscn.org/about-us/>,
accessed on 16 June 2020.

UK Student Climate Network (2020) 'we, the students, demand...', available at:
<https://ukscn.org/our-demands/>, accessed on 16 June 2020.

United Nations Treaty Collection, (2020), available at:
[https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27)
[d&chapter=27](https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27), (accessed 5 July 2020)

University of Liverpool (2018), available at
<https://news.liverpool.ac.uk/2018/09/06/local-schools-take-on-future-food-challenge/>,
(accessed on 3 July 2020)

Van Dijk-Wesselius, J.E., Hovinga, D., Maas, J., van Vugt, M., van den Berg, A.E.,
(2018) 'The impact of greening schoolyards on the appreciation, and physical,
cognitive and social-emotional well-being of schoolchildren: A prospective
intervention study', *Landscape and Urban Planning*, 180, pp. 15-26.

- Van Kernebeek, H., Oosting, S.J., Ittersum, van, M.K., Bikker, P. and Boer, de, I.J.M., (2016) 'Saving land to feed a growing population: consequences for consumption of crop and livestock products', *The International Journal of Life Cycle Assessment*. 21(5) pp. 677-687
- Vaughan, A., (2019) 'Climate protest goes global'. *New Scientist*, 241(3221), p. 7.
- Viorica – Torii, C., Carmen, A., (2013) 'The Impact of Educational Technology on the Learning Styles of Students', *Procedia - Social and Behavioral Sciences*, 83, pp. 851 – 855.
- Walker, C., Beretta, C., Sanjuán, N. and Hellweg, S., (2018) 'Calculating the energy and water use in food processing and assessing the resulting impacts' *international journal of life cycle assessment*, 23(4), pp. 824-839.
- Weindl, I., Popp, B., Bodirsky, L., Rolinski, S., Lotze-Campen, H., Biewald, A., Humpenöder, F., Dietrich, J. and Stevanović, M., (2017), 'Livestock and human use of land: Productivity trends and dietary choices as drivers of future land and carbon dynamics', *Global and Planetary Change*, 159, pp. 1-10.
- Westwella, E. and Bunting, J. (2020). 'The regenerative culture of Extinction Rebellion: self-care, people care, planet care' *Environmental Politics* 29(3), pp. 546 - 551.
- Wiesche, M., Jurisch, M., Yetton, P., Krcmar, H., 'Grounded theory methodology in information systems research', *MIS Quarterly* 41 (3), pp. 685-701.
- Willis, J., and Edwards, C., (2014), *Action Research: Models, Methods and Examples*, (North Carolina : Information Age Publishing), accessed through the University of Liverpool Library Catalogue, pp. 1 – 343.
- Wilkinson, N and Baker, T., (2019) 'Will technology solve teacher workload?', Nesta, available at: <https://www.nesta.org.uk/blog/will-technology-solve-teacher-workload/>, accessed on 12 August 2020.
- Withers, P., Neal, C., Jarvie, H. and Doody, D., (2014) 'Agriculture and Eutrophication: Where do we go from here?' *Sustainability*, 6(9) pp. 5853-5875.
- Wortman, S. and Lovell, S., (2013) 'Environmental Challenges Threatening the Growth of Urban Agriculture in the United States', *Journal of Environmental Quality*, 42(5), pp.1283 - 1294.
- Wrigley, E., 'Energy and the English Industrial Revolution' Wrigley EA. *Philosophical Transactions of the Royal Society A*, available at: <https://royalsocietypublishing.org/doi/10.1098/rsta.2011.0568>, (accessed 3 July 2020)
- Yedla, S. and Garg, S., (2014) 'Two Decades of International Climate Negotiations - Carbon Budget Allocation Approach to Re-shaping Developing Country Strategies', *Journal of East Asian Economic Integration*, 18(3), pp. 277-299.

Zhong, W., and Haigh, J., (2013) 'The greenhouse effect and carbon dioxide', *The Royal Meteorological Society: Weather*, 68:4, pp. 100 - 105.

Zoellick, B., Nelson, S., and Schaufler, M., (2012) 'Participatory science and education: bringing both views into focus', *Frontiers in Ecology and the Environment*, 10(6), pp. 310-313.

Appendix 1 - Environmental education in the curriculum

Subject area	Key Stage	Concepts in the curriculum	Mapping of concepts onto Future Food Challenge
Science	3	Healthy diet; photosynthesis; ecosystems and their role in food security; composition of the Earth; effect of human activity on climate change	Behaviour change and healthy eating, discussion of population change and food security and the carbon footprint of conventional agriculture
Biology	4	Health and disease; the importance of biodiversity; selective breeding in agriculture	The need for healthy food to prevent diet related disease and the integrated food cycle.
Chemistry	4	The life of products and recycling; carbon resources; uses of fossil fuels; atmospheric pollutants; Earth's water resources	Use of fossil fuels in production of chemical fertilisers and food transport, global water usage and water recycling in aquaponic systems
Physics	4	Renewable and non-renewable resources	Global depletion of fossil fuels
Citizenship	3	Role of public institutions and voluntary groups in society; opportunities to participate in school based activity	Social enterprise, starting a movement, local community initiatives, providing an aquaponic system for schools
Citizenship	4	Contributions of citizens to the improvement of their community	Eco-activism, examples of innovators in sustainability
IT	3	Creative projects using a range of devices/software	Highlighting CAD software, introduction to online project management tools
IT	4	Developing computational thinking skills; online privacy; reporting concerns	Introduction to industry 4.0 innovations in urban agriculture

Design and Technology	3	<p>Understanding user needs; reformulating problems; computer aided manufacture; investigating emerging technologies; impact of design and technology on individuals; society and the environment; using programmable components</p> <p>Understanding the source and seasonality of a range of foods</p>	<p>Conducting market research, double-diamond design process for problem solving, introduction to new technology and industry in urban farming, introduction to theories in sustainable development, introduction to industry 4.0 innovations in farm management</p> <p>Understanding seasonality and where food comes from</p>
Geography	3	<p>Weather and climate; population and urbanisation; human impact on landscape, environments and climate;</p>	<p>Estimated population growth, urban and rural spaces, human use of land for agriculture, the carbon footprint of conventional farming methods, food security concerns from climate change</p>
English	3	<p>Speak confidently and effectively through classroom discussion; short presentations; debates and structured discussions</p>	<p>Small group mind mapping activities and feedback to larger group, presentation of research, group decision making for product development</p>
English	4	<p>Organising information and ideas effectively and persuasively for formal spoken presentations and debates; listening to and building on the contributions of others, asking questions to clarify and inform, and challenging courteously when necessary; working effectively in groups of different sizes and taking on required roles, including leading and managing discussions, involving others productively, reviewing and summarising, and contributing to meeting goals/deadlines</p>	<p>Delivery of a company pitch to a panel of judges at a final competition, group decision to decide on progression of product development, group learning from feedback after completing separate activities, constructive criticism at feedback sessions, team leader roles to deliver sessions, producing project management plans, academic posters and time management plans e.g. Gantt charts</p>

Appendix 2 – Participant 1 Teacher Interview

Participant 1

30.6.20

Duration: 57:10

AW: Basically what the research is about is erm, obviously since I've been volunteering with Farm Urban and looking at the development of the Future food challenge, it just, I've been doing a lot of work and research around environmental education in the UK and then how EdTech can do anything to fill the gaps. So the primary questions that have kind of come to me towards the second bit of of my MPhil, is really around the motivations of why people do things, because there's so many different reasons why people may be involved in a project like this and also be passionate about it erm, so most of the questions are based kind of obviously around your experience of the project but also about environmental education in general and obviously there's no right answer, I'm just interested to hear what people say. So the first question is how did you hear about the Future Food Challenge, and what motivated you to, why was it something that you volunteered to do?

P1: Yeah, I think initially we heard about it because we went to the Big Bang event a couple of years back, and at the time I think it was Paul and Jayne [from Farm Urban] giving out free samples of their smoothies, and they were saying there was going to be a project starting and it just looked like really engaging, it looked like a project that we had literally never seen anything like before because a lot of the time in schools it's robotic projects. So it was really nice that it had something to do with the environment and that pupils could get like hands on and build something. And actually have like a tangible project at the end of it. For me personally I was really inspired by the aims of the project. I t hought it would really captivate the pupils and would allow them to work together and stuff like a real life project. And a lot of the time pupils like how is this relevant, why does this matter, and I think that was a really key focus, it was so obvious to students doing the project how relevant it was to their lives and the people around them as well. So I think that's pretty much what motivated us to get involved - something a bit different and that the pupils could really get their teeth into.

AW: Yeah, well that's good. Erm, what was the most important thing that you wanted to get out of the project when you started it?

P1: I think primarily I was looking to hopefully get like students like looking at STEM links, erm, like in the wider world rather than like I say just sticking to the curriculum all of the time. And I thought it gave the pupils an opportunity to complete a project unlike any other that we've done and we really liked the fact that we could link to a local business, the university and make all those links, because we find in school it's so much more appealing to the pupils when it's like people who are quite young, people are from a similar background to them and like success stories, so we're starting to incorporate that into our science capital more, we're always trying to look for local people, local businesses, that's something really inspiring and interesting to do, so it ticked loads of boxes for us really.

AW: Yeah, yeah. And, how much do you feel that your school already facilitates anything to do with the environment or sustainability so that's both in lessons but other spaces in school maybe like the canteen, or any other eco clubs or anything like that?

P1: So we've got quite a big eco committee erm, and they they do like audits quite a lot round school and they're always looking to improve services for the school, and do like campaigns, so if it's like erm, fairtrade day or like they'll put posters up about reducing plastic use, erm they sometimes do little assemblies on reducing electricity within school, we've got a wind turbine as well in school.

AW: Oh right that's amazing

P1: Yeah, and we've got a farm as well, so I think like that links to the environment obviously because we're thinking about rubbish. Not always from the environmental point of view, but if the rubbish is damaging the animals, if rubbish gets through to the farm it can kill them. So we do it in a roundabout way like that really. I think, I'm not 100% sure, but I think the eco committee maybe got a local artist in and they did like plastic collection and they made art from the plastic that had been collected. Is that the type of thing you mean?

AW : Yeah absolutely, so just kind of like awareness of that, and do you think that there are students that become really passionate about it or do you feel like it's kind of quite ingrained in most of the students that you teach would have some level of awareness about it.

P1: Erm, I think like because we have an eco committee and every form has eco reps -

AW : Oh okay.

P1: So it's not just like one pupik from the year group representing so like two pupils a form, they don't always go to all of the meetings, but they'll do our form audit and they'll ask and that will get fed through, so the pupils are always being made aware of it. Some are a lot more passionate than others, and some represent the school at different conventions and stuff like that, but I'd say all in all pupils do have a good knowledge of it in the sense that they've got a responsibility and they're aware that our school has an eco commitment. There's a big cycle to school programme so we encourage pupils to think about that and erm, there's like 'cycle to school week' every now and again, and pupils do cycle into school every day there's like prizes for them, or they get a free bikers breakfast.

AW: Yeah

P1: So if they cycle in they can get a free brekkie every day, and that helps with like, that's a bit of a mental/physical health thing but also that's the environment as well.

AW: That's really good, that's brilliant. So do you feel like, how, how much is the environment something that personally takes up your thought space, kind of in school, or outside school?

P1: Can you say again sorry?

AW: How much does the environment and sustainability, thinking about the environment, take up your thoughtspace? Like is it something that outside of school or in school is like a big priority for you? Or is it something that is a bit further down the list compared to other things?

P1: Do you know what, when we were saying thinking about lockdown, a few months ago I would have said 'I'm not as good as I should be' and I'm still nowhere near as good as I should be, erm, but it's definitely something that like during lockdown we've been asked to rewrite our KS3 and 4 schemes and we've been putting, well I personally have been putting a huge amount more focus on sustainability and the environment any opportunity we can really, so one of the lessons we write lessons to Boris Johnson, another lesson we're doing erm, like, erm, strike for schools climate change where they make their own banners as like an education tool, and with lockdown, quite a few of our lessons are based on like COVID erm, you know, pollution has gone down by like 27% so getting pupils to look at data and see, we get students to look at think like how we could make really small steps to have a big impact and change over time. Because we said, you know, obviously it's not sustainable and the fact that you can't just keep pollution down but it's you know, because everyone stopped, but it's helping the pupils to see different ways in which we can continue to reduce it really and I think the Farm Urban the project helped me a huge amount with that, and we're doing another project with Unilever and that really helps our pupils and me to focus on like better ways for the environment and sustainability yes, absolutely.

AW: Yeah, yeah. And are you aware when you said about the climate strikes, are you aware of, like, how many students kind of take part in that? Do you, do you, often have students taking their Fridays off to go and strike or?

P1: No sorry, no, we don't have any at all, not that I'm aware of. It's not something as a school that we've ever promoted or pushed or even like signposted pupils to if we're honest. So that's where during lockdown we've put it in a lesson. I'm not saying that we'd actively encourage pupils to do it, but I think maybe a lot of them don't even know it's something that happens, like, you know not to be rude but a lot of them see Greta, and all they see are the funny memes, they don't really appreciate that like a young woman is really doing a huge amount to promote sustainability and like you know, reducing global pollution and stuff like that. So I think that's something we should try and address a little bit more, I know that I don't do that at the moment.

AW: That's really interesting about hearing about Greta in the context of memes and the discussion around her rather than what she's actually doing.

P1: I mean yes, that's maybe a bit mean of me to say that and it's not all of our pupils obviously it's not all of the pupils - but if there's a powerpoint and it's written down and you say 'do you know who this is' and they're like 'oh yeah, she's annoying' and I don't know whether that's just because it's someone that's a peer who is really trying harder to make change and they just don't relate with it, I'm not, I'm not

entirely sure, but it's something that I can definitely find out a bit more when I go back really.

AW: Yeah, that is really interesting.

P1: Yeah, maybe I've just tarnished them all there [laughter] but you know what I mean!

AW: Yeah I definitely know what you mean, I mean you don't know who has been taught about what really, but if that's the type of thing you hear and she goes up on the screen and people are like 'oh she's annoying' like obviously that's come from somewhere, so like, it's interesting to think why. Erm, so how do you think, obviously you've got the garden in your school, how long has your school building actually been there?

P1: I think it's a new build, it's a brand new building, I think I want to say 2000... it's either 2007 or 2011, I'm not 100%, but it's a relatively new school. But it looks brand new everyday because basically our support staff are incredible and we encourage our pupils to keep it nice and tidy but the premises team are amazing and so I think the pupils really respect the building because it looks so lovely and so new and you know, it's a good, it's a good space to be in, but I think that the farm's been evolving ever since it opened.

AW: Okay and is there much built into the way that the building is that you're aware of that's like, that promotes sustainability kind of like, automatic lights turning off, or...?

P1: Yeah we've got automatic lights that turn off in halls, and once you're in a classroom if you don't move they go off. So we've got that. Obviously we've got the wind turbine, I'm not sure about the water, I'm not sure if that comes from like water butts and I'm not entirely sure. I don't know whether some of the toilets are flushed using water that we've caught but I'm not entirely sure. Erm, we used to have like a beehive, but when the lady who worked in our school retired she moved the beehive to like a local area because unfortunately no one took it on, but we used to do that as well, and that.

AW: Oh that's cool, that's interesting. Erm, okay so, when you were teaching the challenge, what was your favourite part of delivering the programme?

P1: Erm, I think my favourite part was just seeing how engaged the students were with it, like they took a hold of it and came up with some creative ideas and just ran with it at the end they came up with some, you know, brilliant end products and I think the nicest thing was just seeing how proud they were of their achievements and they really had a sense that they'd done well and they'd made something that fit the purpose for the goal really.

AW: I mean it was amazing what they came up with, it was great.

P1: Yeah from all the schools, all the pupils you know, when you see how far they'd come like they start off when they go on the first day, and they're all a bit nervous and

they keep to their own school, and by the end they become really strong friends, really know their own mind and what their own strengths are and they really develop their own confidence.

AW: Yeah, and obviously you kind of started to deliver it, you've delivered it twice and then twice and a half?

P1: Yeah unfortunately [laughter]

AW: So each time that you delivered it, have you found that when people get into groups, kind of design engineer, managing director, do they still tend to get into groups of friends or by that point, either, do they get into groups of people with different skills?

P1: Yeah, erm, we to be honest we've not noticed erm, in the first year I think we thought 'aw, the girls have got together to be the creative designers because they feel like that's', but in fact we were wrong, but they had really gone into a group where they thought their strengths were most required. We didn't really get too far with it in the third year but in the other two years. no. I feel that people really did have that 'well this is what my skills are and I'd like to do this', and I think part of that that is from when you know when they initially applied?

AW: Yeah

P1: And they gave a bit of background to the type of job and I think that really helped pupils to focus and think 'well actually, you know, if I was doing this, what area might I like to go to?'. Yeah, no I really do think that was something that was one of the strengths, they didn't just go 'oh this is my friend', and to be honest a lot of the pupils that applied weren't friends in the first place.

AW: Oh okay.

P1: There were people who got on it, because maybe forty/fifty pupils applied, there weren't like groups of five that came together really, they knew each other but weren't necessarily strong friendship groups at the beginning.

AW: Yeah, and did you, how did you kind of find the dynamics within the classroom, like were there many arguments or did people just kind of get on with it or how was it?

P1: Yeah, I mean we were really lucky to be honest because the pupils all got on really without a hitch, just the characters, the personalities they were quite laid back, and if they ever did get stressed out I think they just took a bit of time out. I think in both years we had one pupil who kind of strayed away a little bit, didn't feel like maybe they had a place in the team, and didn't feel like that they could maybe flourish as much as they would like to, and they ended up taking on like different roles, so I think in the first year, [member of class] he kind of lost his way a bit so he decided that he felt his skill set was like making a video so he started filming everything and made a little presentation and then, I think the second year, someone felt a little bit more like, I think in their head in the project, they thought they'd be

doing a lot more with the Pod and the fish, and they became a little welfare manager of the fish and we just dealt with him that way really, because -

AW: Oh okay.

P1: he got a little bit lost. But generally speaking the pupils got on really really well and they played to each other's strengths to be honest.

AW: Oh that's great. What did you find the most challenging part of delivering the project?

P1: I think just the time. I think, like, obviously all the activities need to be done to, like, make it a complete overall project but I think getting it done in an hour after school was really, really difficult. And erm, I'm probably if I'm honest, a little bit rigid, like I love a routine so I was like trying to stick to it and get through it, so I think for me, keeping on track with the pupils was like erm, was difficult but. If you said to the pupils it's a two hour project every week, I think they'd engage with it and want to do it, but you know in the winter it gets dark and we try to keep it down to about an hour or so.

AW: Yeah, yeah that makes sense. And what did you, was there any part of the project that you just didn't really enjoy or didn't think needed to be there?

P1: No not at all, erm, I think that we hopefully got the students to see that every activity had relevance in helping them further down the line, and helping them to understand why they were doing certain things. We didn't get any negative feedback from pupils at any stage really. Sometimes we were frustrated because things weren't, they weren't completely sorted as fast as they wanted, or there's little bumps in the road like we didn't get research back from people they wrote letters to straight away, but again it was just a learning curve it wasn't something that put them off really.

AW: Yeah and your team obviously, they actually got approached by Sainsbury's or was it?

P1: [Laughter] Oh yeah!

AW: Could you tell me a little about that because I can't remember the details?

P1: Yeah it was funny actually, they were writing I think such convincing emails, they wrote to like loads of different companies and were just, was that the first year or the second year?

AW: I think the second year?

P1: Oh yeah because they were doing the supermarkets weren't they. I think they just sent a questionnaire out and said 'we'd love to hear from you, we'd love to know if it's the type of thing you'd invest in in the future, and what would you be willing to spend? This is how we think it would be in your supermarkets'. And then they emailed back, I can't remember if it was a phone call or an email, I think it was a phone call, they spoke to me, and I was like 'oh no it's just a project that the pupils

are doing!'. And they wanted to know all about it and you know, wish the pupils loads of luck and said it's something that sounds really, really good for the future, and projects like that are fantastic. And then I think in the first year quite a few of the food banks were really interested in finding out more about it and then we looked into it and I think there was one based maybe in Manchester that was doing something similar from the college?

AW: Oh right.

P1: Yeah and I think the pupils were like doing research on it and found out that similar things were going on.

AW: Oh that's really interesting.

P1: But that's really, that was one of the things that the pupils loved most. They loved hearing back from shops, supermarkets, the food banks, because it really, like, made it real for them and they were like 'oh this person said that, this person said this, this person said that they'd invest £6,000'. This person, you know, that really really motivated them a lot towards the end because they felt it had purpose.

AW: Have you been aware of anything that any of the pupils have got involved with since that's been related or do you think that the potential with students who take part in the project to kind of maybe try and set up a business or design something themselves or?

P1: Erm, I don't think that any pupils have gone on to like, do a business in it, but I know [a member of class] from last year, I sent Jayne [from Farm Urban] pictures the other day, he made a full one in his own home, an aquaponics setup in his back garden. And he's fully resourced, he's got his fish in there and he's growing all kinds, so just in terms of his personal interest he's done really well. Erm, but I know some of the girls that did it last year also did the Unilever project. They've kept a real interest in that type of field really, because whenever we talk about jobs in science they're like 'oh do you remember when we did this?', and they link back to it a lot, so it's really like a sustained interest I think.

AW: Oh that's good. And did you feel that the preparation that was required of you to deliver the project was manageable?

P1: Yeah, absolutely no problems at all like I always think like the more resources the merrier so I was made up! Yes it was resourced brilliantly, no problems at all with that.

AW: Okay, what skills did you feel were the prominent skills that you, actually before that, do you feel that there's like, a skills framework that your school uses to assess developing skills? Is it something that is spoken a lot about?

P1: No, no it's not at all, erm, unfortunately because the project was cut short this year, I know Jayne [from Farm Urban] showed us some really brilliant tools for mapping skills, but unfortunately we didn't use them at all, but it's definitely something that I'd like to spend more time looking at because they were

brilliant. Just a really good way flagging up all the skills that you're developing within the lesson and that, I thought it was really good.

AW: Yeah, so from a personal point of view from the previous years that you've done it what is your personal understanding of the skills rather than a framework because you said that's not really prominent, what skills were you aware that you felt that the students were developing the most in during the project?

P1: Yeah I feel that communication is obviously a massive one, because even when they did the first pitch after they first wrote it they all stood there looking down and even the listeners were still colouring in, and didn't really give very much feedback. But the day before the morning of the competition they were pumped up with confidence, the audience who were listening were giving really active feedback, they were engaged and listening. So I feel like obviously communication really developed, confidence, teamwork, leadership, they all developed creative skills as well, and I think massively for our pupils a lot of social skills they developed. And I think primarily that was the most important one, in just, communication and social development I thought were really, really good.

AW: Yeah. And the team leader roles in the programme, the way that each week there's someone else who's nominated to be it, did that, I think that kind of had mixed success in schools, about whether people could actually do that. Did you find that okay? Or did you have to ditch it a bit?

P1: If I'm honest we pitched in a little bit, just purely because I know the students are really confident in using computers, but I was surprised, you know like, even just reading 'whenever it's in brown click it, give the team instructions', and the first few weeks we picked students who we thought were the most confident and they didn't mind saying 'oh you need to listen up now' or I think is such a big barrier because some pupils don't really like that limelight, and we sometimes found that because we knew we only had an hour, an hour and twenty minutes, if we just got the pupils working and then they led the team where they went off to and saying 'oh keep on track, report back', that type of thing, so there's probably something that we should have taken a bit of advantage of a little bit more, or plan for that a little bit better we probably didn't really use it as it should have been if I'm honest.

AW: Oh no, that's completely fine, it's whatever works in the classroom definitely! This might be an impossible question because you didn't have much time, to work with it but with the new platform, with the way that that was set up, obviously you haven't really done the slides yet, but with the way that it was set out on the platform, do you think that that will potentially make it easier for students to lead the teams, because it's got like more tick boxes and things like that?

P1: Yeah potentially, I think what we'd have to do with that is give pupils a little bit more forewarning. Obviously I know they're meant to know the week before, but you know, say, 'this is going to be a running programme, you are going to be the leader, just get yourself confident with the material online and you know, be ready, and we're here for support, ask us any questions but go for it'. Yeah, you know me, we should have given the pupils a few more opportunities to do that to be honest. And

we did give some of them the chance and they were brilliant, and others were like ‘oh we don’t want to do it’ so it’s just really reading the pupils a little bit better I suppose.

AW: Yeah okay. And which activities were the ones, or which type of activities were the ones that you, you’ve kind of already answered this already, saying that when you reached out to supermarkets and things that really seemed to inspire people. So, the question is just which activities did you see students kind of engage with the most? Like the ones where they’re engaging with the Pod, or when they’re doing the market research? Or which type of activities?

P1: Yeah, erm so, I think like you say, when they got feedback about the market research, they really enjoyed that because it felt like a real experience and it was a project that applied to people. I think in our first year as well, the pupils really liked doing research into how to get funding from charities.

AW: Oh okay.

P1: So they went on the Trussell Trust and found out quite a lot about, erm, what food banks were doing, how much food was needed, and why fresh food was so important. And from there they got lots of links to other organisations who might be able to provide grants. So they quite liked looking into that and finding out, if it was to be real, how they could support a business and that type of thing. And then I’m just trying to think what else, Oh obviously the pupils LOVE erm making the Pod so it’s the team, they all really enjoyed making it in the first few weeks. But then the ones that actually designed and built their own, they loved getting really hands on and building it, because the pupils were really, they’d come back up and say ‘we’ve done this today’ and they were amazed by it and really enjoyed seeing it. Looking back to the picture, and saying ‘it looks like this or it doesn’t look like that but we’ve changed this because...’, erm, the whole team were really engaged by that when they bring it back up.

AW: Yeah.

P1: Also they really liked writing the pitch, which I didn’t think they would to be honest, I thought they might think ‘ooh’, obviously [another member of staff], who does the project, she worked with them a lot on that and helped them develop it, but I think they really liked the idea of trying to convince people that their idea was a good idea. So yeah, they quite enjoyed that. Whereas last year, I think they enjoyed more, like designing it, and trying to make it more, like, suitable for people their own age, they seemed to be more interested in younger people rather than the group who did it the first time round. So yeah, I think the research, the marketing element, anything where they were together as a group and was hands on really, so building, making, doing.

AW: Yeah. Did you have, I can’t remember if it was your school or other schools, but did you have much to do with your DT department when you were making it or was it in the lab?

P1: Ours was a bit ad hoc and we realised like that we didn’t really [laughter] know what we were doing! So we had a really great DT teacher, and said ‘any chance you

could come up and help the pupils get started?’ The first year we did it all on our own, erm, up in science, but the second year like the pupils were like ‘oh if we go down to DT, sir will help us get the tools that we need’ and erm, they I think last year, our pupils designed it down, is it ECAD? designed it down there, and one DT teacher really helped, and was really interested in the project as well, and really got involved like we were, so became part of the project. But I wouldn’t say it was really, and that was my fault because I didn’t open it up to the whole STEM team, I should’ve said ‘this is what we are doing, why don’t you get involved? I think part of that is I’m conscious that everyone’s really busy. So I feel like if I’ve taken on a project, I can’t say ‘oh by the way, I’ve done this and you need to help me this week’. I think it needs to be a little bit more collaborative in the future, and say like ‘we’re hoping to do this project, can anyone spare a few hours’. But the teacher who got involved was amazing, he was really, really interested in it and that helped the students get interested in it as well.

AW: Oh that’s really good I know that it’s hard getting that balance between, you don’t want to put on anyone else, but at the same time -

P1: You’re like ‘help!’ [laughter]

AW: [Laughter] Yeah. One question is just, when I was doing my research, I came across a policy that was introduced in early 2000s which was a national framework for sustainability. So it was a policy under Labour, to erm, to introduce sustainability like, kind of, more into the curriculum but actually have it as an Ofsted thing that was inspected in schools to see how the school was dealing with sustainability. Erm, and it got ditched in 2009, erm, so I was just wondering, I’d never heard of that before, but it seemed like a really comprehensive policy that then was like, kind of, ditched. I was wondering have you ever heard of that before? Or like -

P1: To be honest, I’ve never heard of that at all, no. And I don’t know if people in our school like senior, would but no, I’ve never heard of it.

AW: Yeah, I mean it’s not surprising because I mean it was, it was ditched before the Department for Education was even the Department for Education, so it is an old policy really, but I just think it was interesting. Because if you looked it up it’s quite a substantial piece of work and it seems really good and it’s the type of thing that students are calling for now in the climate strikes now and things, but obviously, just kind of just got dropped, so I was interested to know -

P1: Oh sorry no, I’ll look into it it sounds good!

AW: Yeah no one I’ve spoken to so far has heard of it either so yeah. Okay, so which, were there any activities that fell a bit flat with students, that they didn’t really seem to get why or just didn’t really engage with?

P1: Erm, I can’t really think of any off the top of my head where they didn’t, you know, didn’t buy into it or didn’t seem the reason why we were doing it.

AW: Yeah.

P1: I'm just trying to think if, I think the only thing that we were a bit gutted that we didn't have time to do more of the Produce Pod activities, and I think they would have absolutely loved that. But obviously we were, to get to the end goal of the project you had to prioritise. But I think really, that they would have really liked to do those, erm, you know when it's like crop yield? And looking at like, bulk, bulking it up and stuff, I think they would have liked that, but maybe that could be a little spin off project or something like that.

AW: Yeah, yeah exactly.

P1: I think the one thing that we found a little bit difficult was drawing graphs, but I think that's just a skill, it wasn't that they didn't want to do it, they just found it a little more difficult. Like you know when we got the data back, erm, like processing that.

AW: Yeah, yeah that makes sense. Okay and how much do you currently use technology like computer programmes or different apps, or computer programmes in your lessons. Or like -

P1: Oh not at all

AW: Or in your department of anything.

P1: Erm, I don't, I mean this is how bad I am, I wouldn't even really know what they are!

AW: Yeah. [Laughter]/

P1: [Laughter] That's not to, like, take away from other people in our department, they could well be using all kinds [laughter], I don't know!

Abby: No that's fair enough, it is all fairly new.

P1: Can you give me any examples of what people might be using or?

AW: So, one teacher erm, oh which I'll send you the link for actually in case, have you ever used kahoot!?

P1: Oh yeah we use Kahoot!

AW: Oh okay!

P1: Oh sorry yeah we use that.

AW: So any kind of like quiz things? Or but, when you're using Kahoot!, do students use their own phones or do they use laptops provided?

P1: No, we use laptops erm, or during lockdown I've sent out a Kahoot! quiz to my year 10s to see who's been doing it, and we've got Seneca as well, Seneca is just like you can up, no you don't even upload them, it's all just pre-programmed on there, you

just select activities for pupils to do, but sorry I didn't realise they were the type of things you meant!

AW: Oh no don't worry! That's fine!

P1: I am that useless [laughter]

AW: Oh no, not at all!

P1: Erm, nothing crazy I wouldn't say

AW: Yeah.

P1: We don't do much really.

AW: Yeah, so it's just kind of occasional things like the quizzes and things.

P1: Yeah.

AW: I've done a few Farm Urban Kahoot! quizzes now, so I can send you the links for them.

P1: Oh brilliant! Yeah that would be great!

AW: Yeah that's fine, no worries. Erm, okay, and did you find, erm, again it's a bit of a difficult one because it's changed a lot now that there's the new platform which you didn't really get a chance to use, erm, but did you find in your lessons was there ever times where the students really did go on the laptops and use the website that existed? Or was it just done from the front more?

P1: Erm, so I mean, when students had to like watch the YouTube clips, like how to put together they could do that, but no, we don't have a huge amount of laptops and every time we use laptops and it is just one of those things, it takes like 15 minutes to get logged on, then the internet's not working, so purely from a time point of view, it's just so difficult for pupils, if we were in a computer room it would be a lot easier, but hopefully, erm, we're getting a lot of Chromebooks into school, so hopefully like, that will be a really big change for us, and computers and IT will be a lot more accessible during lessons for our pupils. Because that's just what gets in the way at the moment, it's not that we don't want to do it, it's just that, and unfortunately it really like makes the start of the session quite like long and drawn out because two people will be on, then four people's aren't working, then they go to It and it's just, it doesn't make the best start. So we often start at the front, then say, if there's any laptops then you can do research, but we mainly do it from the front.

AW: Yeah that makes sense. And when you say that you're going to be getting Chromebooks in, was that something that was in the pipeline anyway, or is that related to covid?

P1: No, I mean I think it was already in the pipeline, I think we got a new leader of IT support in and I think I spoke to her maybe in October and said like 'it's a long time

coming school it really needs it', and that wasn't a criticism of the school, it was just in terms of funding that we've got available. We were talking today in school actually, and were saying that it's such a shame we didn't have Google Docs and stuff before lockdown because then we would have had a completely different expectation on pupils' communication through like you know, from home and stuff like that, but it's one of them things and we're hoping to get it up sooner rather than later, so we had a meeting today about how to docs and slides and stuff so it might be a different picture next year, where pupils can access it a little more easily.

AW: Yeah that makes sense. And did you feel, I mean you touched on this a bit already, but do you feel that the programme had any impact on your continuing professional development?

P1: Yeah, I mean obviously before I had really limited use of programmes, apps and platforms, and stuff like that, it has really helped me become a little bit of a better communicator in systems and programmes that I never ever would have used before, and like, unfortunately we haven't had much use of the new one, but that was like when I started that would help me develop a lot further as well.

AW: Yeah, yeah,

P1: Definitely.

AW: That's good. Erm, and what erm, when on the teacher training day we looked at the platform, was there anything about it that you thought, 'this would be good if this aspect could be developed further' or was it, you just haven't had time really to think about it?

P1: Sorry no, I'm sure it was all brilliant, and I'm sure there'd be nothing I could suggest to improve, but I think it was just, on the day it was really exciting finding all the different things, but three weeks in we had to stop unfortunately. So, we've not done it since really.

AW: No that's absolutely fine, I'm really not expecting people to have been on the platform much, but just wanted to check because different people were at different lessons and stuff.

P1: Yeah. I think, when you couldn't complete some things, and it was because of me, I don't think I'd clicked certain things were done, so I think I emailed a few times saying 'aaah' but I'm sure the pupils would be a lot more confident at that than we are maybe.

AW: Okay and how successfully, I mean obviously COVID has been really interesting for this because everything has moved online so much in the last couple of months but how successful could you envisage this programme being remotely rather than with the in person support?

P1: Yeah, so I think me and [another member of staff] were saying like, from our point of view, like how we run it there's still quite a large amount of teacher input using the current model. Purely from the vast amount of work that has to be

completed, so we helped pupils prioritise work, make targets, but erm, it was set up slightly differently like the one that they've sent out for like schools to have a go, I'm sure that would be really manageable for pupils in smaller chunks, reducing the size of the project and making really smart targets for them, I'm sure there'd be no reason why they could achieve that like online without support from teachers.

AW: Yeah, yeah that makes sense.

P1: I think that something that we've like as a school found always really brilliant from the project though is when Paul and then team [from Farm Urban] come in, because we've said at the beginning that it's a real way for pupils to see businesses in the local community being successful, being interested in science and you know solving real life problems, so it would still be great if it was a remote programme that there would be some interaction with the team, purely because they're so engaging with our pupils and really relate to them and I think really that has a big impact on the number of pupils that apply to do it. If I just stood at the front and was like, 'there's a project coming', it would be nowhere near the same amount of pupils interested in doing it, so it would be great if that part could still exist really.

AW: Yeah, do you feel kind of with your school erm being outside of the city centre and kind of outside of Liverpool generally, do you think that your students kind of engaged with it as a local project, as a part of Merseyside still?

P1: Yeah, I really do think so. Particularly because like a lot of pupils, We have a lot of contact with like John Moores and Liverpool University so it is like you know yeah, I think they definitely do feel that link.

AW: Yeah erm. Have you erm, what do you think is the most important thing to you. like in general outside of the project, when you go into school each day, what's the most important thing to you that you are trying to get out of lessons for your students? I mean obviously there is a variety of different priorities you can have, but do you...?

P1: Yeah, I think it's really erm, that pupils leave feeling good about themselves and that they've achieved something, and they can, you know, come in the next day feeling like they can do it again, maybe that's a rubbish answer sorry!

AW: No! It's really not, it's the perfect answer.

P1: Just to give them confidence to be able to do it and want to do it really.

AW: Yeah, and what specifically you know when you went into teaching and teaching the science subjects, what was it about science that you wanted to teach or was that something that it was a subject that you liked, and you'd done at uni?

P1: Yeah, I think so to be honest, I think it was just something that I really liked and something that we're really lucky when there's projects like this now that will help to light the bulb for the pupils and you help them think that it will be relevant for them and that it will be interesting for them as well, and that there's a future for them in science definitely. Because it is hard sometimes when the curriculum is quite dry, helping them to see like why it's important and why it's relevant and as awful as

COVID is there's loads of really good points for us to introduce into lessons now and be like 'look this is so important' and so you know, as bad as it is, it's hopefully helping the future's scientists -

AW: Yeah.

P1: Get really nice jobs and do things to help!

AW: Yeah and do you feel in the curriculum that you teach, do you feel that environmental issues feature a substantial amount in the curriculum? Or do you think that that's something that maybe you emphasise a little bit more? Or like how much do you think it features in the curriculum?

P1: Erm, I think that, like, erm, I think since we've been rewriting our programmes of learning for key stages 3 and 4, just on a personal level, I've definitely trying to introduce it more, like in our opening slides for careers, or how it links to you, so I think like for me individually it's definitely become a much more important part of the lessons. But I suppose the schemes I've been writing I've been really lucky because I've done like chemistry and the atmosphere, I've been doing 'using resources', so a friend who's doing structure and bonding might find it a little bit more difficult to make as many links. And then like yeah, I think as much as we can, but always there's always room for improvement I could definitely put more in, and I think like to be honest, I think to be honest I should be working a little bit more with the Eco Committee, find out what they're doing and see if we can team up a little bit more I suppose.

AW: Oh that's a good idea, sorry I don't quite understand, so when you're, when you say it's easier for you because you work on this topic and it's a bit more relevant, do you within your department have different topics that are like divvied out between you erm?

P1: Yeah absolutely, yeah so erm like during lockdown, we've all been given certain units to plan and develop, and it's like a basic framework of a scheme of learning and then each teacher will get it and they'll modify it for their class, so I'll try not to bore you! But how it looks like -

AW: No, no it's really interesting

P1: So say I'm doing erm, 'using resources', I've got like seven lessons to plan, erm, to make it generic for the whole team, we have like erm, a science capital slide, so that might be and everyone will have to do that in their schemes so that will be like a local business, it'll be a career that they might do, or it will be something interesting in the news, then we'll have new information, so anything that's new and relevant for the scheme, and then we'll do like suggested teaching activities, so that's what we do. So that's why I'm saying 'it's okay for me' because I've had ones that have been completely relevant to the environment and sustainability whereas, maybe if you were doing a physics unit on the electromagnetic spectrum, it might be a little bit more difficult or I'm sure there is a link!

AW: Yeah.

P1: [Laughter] There definitely will be now I've said it! So yeah, just a bit more simple for certain subjects and certain topics.

AW: Yeah of course, and do you feel when it's in, when the topics that are associated with the environment appear in the curriculum, like so anything to do with human impact on the environment or anything like that, do you think that the curriculum phrases it in terms of climate change? Or do you think it's very much like 'this is how the world works' and general explanation of how nature functions or in relation to climate change?

P1: I think we're trying to like get as much as we can linking it to climate change and the impact of people, but I think but obviously we'll do that through discussion and through, you know, activities but I still think that how the GCSE is written, the questions that the pupils have to answer is very like scientific factual erm it'll be based on data, or it will be based on - pupils will have to know what causes global warming and how climate change occurs rather than like human impact, influence, stuff like that really.

AW: Okay,

P1: I think.

AW: Yeah. And do you feel that when, when anything in the curriculum talks about sustainability or the environment or kind of guidance from Ofsted or any things that influence the way that you develop, do you think that anything to do with the environment really comes from the government or should come from the government? Or do you think that schools really develop that themselves? Or should develop that themselves?

P1: I'm sorry I missed that.

AW: Sorry that was a really poor way of explaining that question!

P1: No, I just didn't hear, you cut off!

AW: Oh right! So do you think that environmental education in school does come from the government or they leave it up to schools to develop their own sustainability practice, and depending on your answer do you think the government should take more of a role in that? Or do you think that it is good for schools to do that on their own?

P1: I think it would be really good if there was initiative from the government which encouraged us further, and made it like you know you said before like the old policy? Because often when school have it as part of an Ofsted it becomes more of a priority, erm so if that was to happen you know schools might take it, not that we don't take it seriously, but might take different action steps towards making it a really big part of our curriculum and have impact. I think currently we get obviously the erm, like, our exam board is AQA so we just get points for what the school will, what the pupils will be examined on and we develop that ourselves and just try to incorporate as much

real life as possible. But I could be ignorant there, there could well be a policy there that I just don't know about.

AW: Well that's always the case in every sector!

P1: I'm not sure there is, I've just not read [laughter].

AW: And what do you feel as a teacher, and talking with your peers, what do you think are the biggest pressures on teachers at the moment? Before COVID really, because obviously that's a whole different kettle of fish.

P1: Yeah that's really -

AW: A different level of stress

P1: Erm, I suppose just, helping pupils to achieve what they're capable of. I suppose like, yeah my biggest anxiety would be pupils not getting the grades that they're capable of and maybe holding myself accountable for why they didn't I suppose.

AW: Right, yeah. That makes sense.

P1: Is that right? [Laughter] sorry, I'm not sure.

AW: No that makes perfect sense as an answer! And sorry, a couple of these questions I didn't send to you in advance so I hope you don't mind, they're things that have just popped into my head!

P1: No not at all! No not at all, I'm just rubbish at answering questions sorry!

AW: No not at all!

P1: No fire away, t's fine!

AW: Okay, so just the final few questions then. Are there any comments you have or suggestions about what you would like to see from the Future Food Challenge in the future?

P1: Erm, well I hope, as you know we absolutely love the project and we really enjoy it and the pupils do as well, so the only thing really, I'd say, is lots of pupils ask questions about it and I run the year 7 and 8 science club, and obviously I don't want to talk to them too much about it because hopefully there are pupils that will do it in year 9, but personally I'd like to run a little side project, even if you know it was just looking at animal welfare, or you know, best conditions for growing plants, or why aquaponics is good for the environment, I suppose that's something I should put some time into so the pupils in year 7 can get to know it a bit more and maybe do a half term project, erm, about it, just to get them a bit more engaged with it really, but that's something that personally I think would be really nice, and I suppose if there were, not that we'd extend the time and the project but if there were opportunities to do the extra activities, erm and maybe if they were a little bit, not simplified, but I suppose a lot of the activities were quite high level demand in terms in maths and

calculations, and I just unfortunately think that sometimes pupils are quite put off by difficult maths. So I think maybe if we introduced it a bit more slowly, or getting them doing something basic that led up to that. Because I know one of the activities they loved doing was when they took the fish out and did a healthcare check on it, you know when you have to look at how it swims, has it got any marks? And I know some of them who were not as engaged, when we did that they really bought into it again erm, so just little things, or maybe probably I should do stuff, like right we're growing basil I want everyone to find a recipe and maybe we'll go down to food tech one day and make it, but you know at the time you're like 'oh no we need to do this!' but maybe I should plan it in a little bit more, I suppose little things like that.

AW: Yeah, and I suppose that I think, do you think that if Farm Urban developed a few more modules that were maybe aimed at different erm, different age ranges through the school, so like a few different resources for like year 7 to do an experiment with the Produce Pod, or you know that type of thing, is that something that you'd be interested in Farm Urban doing?

P1: Yes definitely, I mean I don't mean to put it back on them because it would be my job, but yeah if they had something like that it would be incredible, and then we could have like a mini club, like year 7 aquaponics club or something like that, that would be really, really good. With certificates or like yeah because we have quite a few pupils come to science club each week, and you know, if we got them engaged with that early, you know, we do a little bit, we tell them what it's about, and they come and have a look at the fish and we chat about how the herbs are growing, but we don't do a lot more than that in year 7 with the pupils because we're doing another project, but we'd be happy, we'd really love to run something along year 9 with the 7s that would be really good.

AW: Do you feel that, you touched upon this a bit before, but do you feel that your feelings about the environment changed at all from taking part in the challenge?

P1: Yeah, I didn't think it would be honest, but yeah absolutely, erm in a really good way. Erm definitely I think a lot more about sustainability, about food miles, I think is a big thing as well. I think that, and erm recycling, and making sure that you're putting a positive image over to the pupils and like, making sure that you're modelling what we're expecting pupils to do, like indirectly, do you know what I mean? Definitely. And this project, I think I mentioned it before, the Unilever one as well has really helped the pupils get motivated to come up with different ideas as to why it's important to be sustainable. Erm because you know we teach the pupils the definition of it and it doesn't really mean much, erm but then when you're talking about how it affects us directly.

AW: Yeah

P1: Then it becomes a bit more relevant to them then as well. I think something I'm saying erm or something I meant to say sorry, you know before when you said is there any follow up? Something our pupils loved finding out was all of the careers that people had before they worked at Farm Urban, they really really loved that, that really engaged them. So I didn't know whether to say that a good follow up would be to say, like, where the business is now, like the Greens for Good? Even if there was a

little video with 'this is an update, this is what we do now, we're based in the basement', show them the new setup and what the different people are doing as their roles and how that's developed because I think the pupils would love to see that and I do feel like the group really bought into the whole idea of Farm Urban as well, and you do feel that you know like, even like saying that, 'oh they're delivering Greens for Good all over the community', or if they're doing any other projects like, stuff like that, they'd like to know more about it I think.

AW : Yeah that's really helpful! That's really helpful feedback, thank you. And I think that when I was shadowing, when I was shadowing some lessons as a volunteer for Farm Urban, it was really interesting to me hearing the different things that students were talking about and the different worries they had on their minds kind of outside of their lessons, what topics do you think from speaking with your students, kind of are you know, the most pressing things for year 9s at the moment? Like whether that's anything to do with social media or different sorts of crime in their area or kind of, any different pressures on them, what do you think are some of the main sorts of topics that seem to affect them?

P1: I think social media is a massive one. Really, really big, and I think believe it or not even in year 9 there's a lot of pupils who are, who feel the anxiety of exam pressure. Erm, you know early on, erm and you know you might not necessarily think it but it's definitely on their minds. But yeah, definitely social media. I think probably relationships is something that's on their mind and like their identities, I imagine, is something that erm is something that, they erm, they do worry about. But I couldn't say specifically really.

AW: No of course, no that's really interesting. Because I think it does tend to change depending on what area the school is in, there's different pressures and there's different ideas that the students seem to be struggling with.

P1: Yeah I suppose like the local community affects them a lot doesn't it?

AW: Yeah, yeah. Erm do you think that the programme influenced any other aspects of your teaching practice or did it just build into what you were already doing?

P1: Erm well, as I say like it's definitely made me, hopefully put the sustainability environment more at the forefront erm, obviously that was something that we were doing when we were writing stuff but it's allowed me to make links to it hopefully a lot more easily.

AW: Yeah

P1: And it's allowed me to find erm, links that I maybe wouldn't have been able to find beforehand, you know because you always say like 'oh, what could you do as a job?' and I'm like, 'ooh I dunno', so I've looked into that more as a result of it and you know it's nice to be able to speak to people and say 'you don't have to do science all your life, you can come into it, there's loads of different pathways into it' and yeah. There's lots of different ways really, it's helped to develop me and make me think more.

AW: That's brilliant. Erm, it's definitely been interesting for me as well because I was not working in science at all, so coming to volunteer at Farm Urban and see how multidisciplinary the team was, I think at any age it seems to have an impact.

P1: Yeah

AW: And I think it would have been really lovely when I'd been at school to see an organisation like that as well.

P1: Umm.

AW: So, yeah it's interesting.

P1: Yeah.

AW: Erm, and then finally, do you, just with what we were talking about at the beginning about what you hoped to get out of the programme, do you feel that, that it kind of achieved what your aims were for the programme both times that you ran it?

P1: Yeah absolutely. Erm like pupils were engaged, they were really proud of their achievements, erm, they got to an end goal where they made something collaboratively, and they got to think a lot more about the environment. So yeah, I think it definitely, like, ticked all our boxes and we were really, really pleased with the way the project ran for the pupils and us and, likem the outcomes for them. Yeah, 100%.

AW: Yeah, well that's great. Well that's all the questions I had for you so thank you so much!

P1: Yeah no problem at all!

Appendix 3: Participant 2 teacher interview

Participant 2

1.7.20

AW: Yeah basically to explain, kind of, what I'm doing, it's been through the research that I've done for my MPhil, I obviously kind of worked with Farm Urban to develop some of the content a bit more, and mainly that was around making the new online platform. Erm, but writing up my research is more around the education side of it, so what the gaps are for environmental education in high schools and how we can try and fill some of those gaps. Erm, so what it kind of comes down to really is looking at the different motivations of people who are involved, so what Farm Urban are trying to achieve by doing this programme, what the teachers involved want from this programme, and what motivated them to take part and just kind of how the different people involved reacted really so that's what these questions are about.

P2: Yeah.

Abby: So I guess the first question is just what, how did you hear about the Future Food Challenge and what motivated you to take part?

P2: So our careers leader at school arranged the talk with Paul to come in, I don't know how that contact came about to be honest. So we got an email saying these guys from Farm Urban are coming in and doing this talk, bring your classes, all the rest, that's usually the only way that we see a talk in school if you're teaching and you've brought a class.

AW: Yeah

P2: Farm Urban must have written something about what it was about and I thought 'that sounds good and I'm actually free that lesson so for the first time I thought I'll just go and listen, and I just went in, stood at the back and was just blown away by it. I thought this is amazing, and I thought that was that, I didn't know anymore about it, what it led onto, and it was a few weeks after, our head of careers emailed staff saying Farm Urban who did the talk are doing this challenge, does anybody want to run in school, we need a member of staff and I said 'Yeah! It sounds brilliant!' so it just went from there really. So I know nothing, I didn't know about their existence before that.

AW: That's amazing, so what was it like, when you heard the talk, what did you take away from the message and what stood out to you about it?

P2: It was things like I know the point that stuck with me are things like the north sea fish has done two laps around the world, that type of thing was just. Because you think, you try and do your own little bits at home, we're pretty okay with recycling, stuff like that, we're not brilliant by any means but we do a bit. So you think that when you do something like buying local fish for instance would be helping, but then not necessarily at all, so it just was a big eye opener really to all those sort of things.

AW: Yeah, definitely when I first started volunteering with Farm Urban I was exactly the same, I learnt so much in that first month it was just mad. So what do you, when you started doing the Future Food Challenge then, what was the, what was the thing that was most important to you about delivering the project, like what did you want the kids to get out of it?

P2: Erm, I'd been made really excited by it all by that talk and I wanted to get the students who had been excited by it as well to continue with that, and realise like I did that you might think you're doing a little bit, but there is so much more you can do. You know the number of bags of salad we've gone through and always half of it going in the bin, and then things like after the last challenge, I brought the system home here just to keep it going, and I didn't need to buy them anymore, and it was no huge, no big thing. We got a Greens for Good box delivered because my husband donated to the kickstarter, and we planted them and they're still what we have for our salad now, so it is only little things, but it's making the right change isn't it, and for the students to know that as well, that, there are still little things, not huge, it doesn't have to be groundbreaking, but making the right ones and just being more aware, not just of buying it from Tesco's, but what it's done to get there.

AW: Yeah, yeah definitely I understand. So, erm, how do you feel that your school currently does about environmental education, so kind of, in your canteen, in your lessons, any kind of clubs, anything like that, how much do you think there's a focus on environmental studies?

P2: I don't think as the school runs it does much, I know, I remember questioning a few years ago why we don't just recycle paper and they said the cost, the cost to recycle it is higher than it is to just bin it, so erm, which I found quite shocking. So as we run in that sense, as we function it's minimal. I don't think that's to do with being we're a PFI school, and the way the money goes to managing recycling and stuff, erm, I don't think, I don't know in the canteen, but I don't think there's a huge awareness in terms of how they function around it. It is more part of the curriculum now than it has been, but not massively. And I think quite isolated. It may be a topic that you cover, but then you move on to something else. It's not really linking it in to everything, and showing how, actually everything's relative to it, or it can all link in to everything you're talking about in some way. I think it's still quite a separate entity.

AW: Yeah, I understand. So what type of topics are the main things that you teach that the environment, climate change kind of comes out?

P2: There's some climate change elements in the chemistry, it's global warming, and erm, what else, I haven't taught chemistry for a long time. Erm, I think maybe they mention the ozone layer but I think it's all that stuff that we were doing from a long time ago really. There's an ecology chapter in GCSE biology, and they talk about biofuels and things like that. But even then, it's not, I don't find it hugely relating to us and our everyday functioning.

AW: Yeah

P2: It's sort of these things can be done elsewhere, and you look at developing countries and you think, not necessarily an alternative source of fuel for them, brilliant, but it's not saying 'do it in your garden'. Or you know. I don't think really it relates to their every day functioning as students I don't think they get in and think 'I can do that'.

AW: Yeah, that makes sense. So when I was doing reading for the project, I came across a national sustainability framework which was a erm, government policy in the early noughties, and it was about trying to bring it into the curriculum but also just generally school life, issues of sustainability. And it would be, and they wanted schools to be completely sustainable by 2020, and erm, it would be like monitored by Ofsted so it was really quite a coherent programme. But in 2009 when the change of government happened that was just, that policy was just abandoned. I hadn't heard of it, and no one I've spoken to so far had heard of it, so I was just wondering if you had.

P2: 2010 was when I started teaching, and I've never heard of it, no. I've never seen any sign of it either. Saying that, my daughter's in year one, and she is all over environmental stuff. And, not largely from us, I mean we do talk about it here, as in which bin and all that stuff, but she's got a lot from school, I don't know where she's got that from, if it's a curriculum thing, or a choice from their school, but she's well into it, yeah.

AW: Do you, do you think that, so what I can get from the government memos and the Department for Education now is that they feel that schools should be empowered to make decisions for themselves, and push that agenda themselves if they want, erm, do you think that that is something that schools would take up in the midst of priorities, or do you think that -

P2: It's the cost. It's the cost always is what everything comes down to, and no, I don't think they will prioritise the spending on that when there's so many things ahead of it. And that's probably why the government are putting it as the schools' responsibility so they don't have to fund it when they should.

AW: Yeah, what do you, erm, what do you think the main priorities, when schools are thinking about how to organise their funding and things are rather than environmental things?

P2: I mean pens, books. It's as limited as that! So it just can't extend beyond that when that's as far as it goes.

AW: Of course yeah. And also over the last year or so, obviously the climate strikes have started with young people, have you been aware of any of your students going on them?

P2: Yeah, yeah. Quite a few of our team from last year from the Future Food Challenge, yes they said that they went.

AW: Oh that's interesting. Erm, okay. So specifically to do with the Future Food Challenge then, what was your favourite part of facilitating the challenge?

P2: Erm, what was my favourite part of it? I think there was enthusiasm at the beginning, but it was loads of different ideas, and it was hard to push them, okay let's make a decision, and move forwards with that. Then they had a bit of a dip in the middle where they, I don't know. Some people had been a bit wounded that they hadn't had their idea chosen, or some people kind of not sure how we were moving it on. I think it was from the build. Once we said, right, we're committing to buying this stuff, and we've got to make this work, then they really, really got into it, and they moved it more. There were times early on when I was having to move it more. It wasn't from, I think maybe some were thinking they were losing interest but some still really wanted to bounce, and good ideas. It was hard to have to shelve that and say 'okay well I think that most of you have agreed on this and we need to move forward.

AW: Yeah

P2: I was, that was a bit hard in the beginning but then once they got into the build and they could see their idea coming together, it was brilliant. It was great, I was more watching them leading and still facilitating but from them asking 'can we do this, we need to do this' rather than me saying 'what are you going to do now?' so it was brilliant yeah.

AW: That sounds really good. Erm, so when erm, obviously the programme is designed so that each week you can have a team leader if that works for your classroom, did that work for your classroom? Or did people shy away from doing the specific team leader role?

P2: Well it's funny, I've had two totally different teams last year to this year. Like last year's were very charismatic, they all had the confidence to team lead, but weren't always focussed enough to do it.

AW: Yeah

P2: I don't know if, last year was predominantly boys, this year is predominantly girls.

AW: Oh right, yeah

P2: I don't know if that's made a difference but this year's team are very conscientious girls, less confident so some more apprehensive about being team leader, but really willing to give it a go and really leading it. Much more than the confident ones who bounced in, and were leading it because they wanted to be at the front, but then not giving much guidance. So it's been really interesting to watch, just by chance, two totally different groups of students.

AW: Yeah. And have you found you know when people were getting into groups? About managing director, design engineer, did you find that people were just, and was there a difference in the two groups, of people either getting into groups with their friends or actually recognising that they wanted to be with people with the right skills to do that role?

P2: I think both times most people seemed to choose a role that they felt suited to. There was the odd pair here and there who were clearly not going to be separated. But I didn't find that across the whole thing. And again interesting because last year they chose the roles before they'd done anything, and most of them put a role on their form and we had a pretty even split between the three.

AW: Okay.

P2: But this year we had the launch day first didn't we, and then they were picking their roles. I think they felt a lot more informed about what they were picking this year, definitely. But yeah I think most of them went on their own skills largely rather than picking to be with friends.

AW: Yeah. Okay, obviously you've said that keeping the motivation up was a bit of a challenge sometimes, but was there anything else that you found particularly challenging about delivering the programme?

P2: There was a lot to get in. I think lots of the stuff, and I've been able to identify that better this year because of having done it last year, there's so many brilliant opportunities thrown in there that you want them to get on board with it all, but you just can't fit that all in one evening. So there's been times where I've had to, and I've known this year, 'okay this is what we've got to get done tonight to move our challenge forward. These are the other things that we can talk about and think about, and I've got a better way to communicate with them this year which we found difficult last year. The school have got a new platform. So I can send them these other things to be looking about and thinking about that don't need to be part of the project necessarily in that time. So maybe an easier way to identify things that are opportunities and ways to evaluate yourself and your skills and things like that. And things that had to be done for you to move your challenge forward.

AW: Yep, that makes a lot of sense. So do you, how do you feel that IT infrastructure is at your school to be able to for students to work on their own laptops?

P2: Great, I mean they haven't always, we've got a science bag of iPads somewhere, which we get them, they're often not charged and things. So we weren't always able to say 'everyone go off and log on and do this', we more tended to stay on my laptop and do it on the projector, which has meant, because we never got to the point this year of the groups breaking away.

AW: Oh right, of course yeah.

P2: Yeah, having their own login on the platform would have worked well for that and if we'd got our iPads sorted or, I never took them up to a computer room, which I perhaps should have last year and then that would have facilitated that, but again last years team, some may have gone off task. This year we wouldn't have had a problem, we would have gone to the computer room, and they would have all cracked away in their teams doing what they had to do. So yeah, the infrastructure is there, I probably didn't make best use of it last year.

AW: And do you use, kind of apps, or different things in your classroom, erm like any teaching things to, or programmes...?

P2: Not really no, with phones being an issue in your lesson, it has to just be nothing to do with them. There's been times over the years school have bought things, we bought some quiz thing and had handsets to be given out but I've not used it in class.

AW: Is that because of the actual organising the technology? Or the students get distracted?

P2: Probably both. I mean, you're so pressured with what you've got to get out of them, everything you're doing you've got to weigh it all up, you know, 'what are we going to get out of this' and if it's five minutes of a lesson yet it's going to take twenty minutes to get them working it and them on task and all the rest of it, it's, yeah, it usually doesn't manage to outweigh the more laptop and talk discussion forms of teaching really.

AW: Yeah, yeah definitely. So when you're teaching in your lessons, what is the main thing that you're trying to get out of a lesson with your students?

P2: Erm, What am I, I can't remember it's been so long since I've been teaching! Erm, what am I trying to...? I suppose, them to grasp new knowledge and be able to apply it to things.

AW: Yeah, that makes a lot of sense. Okay, so which skills do you, or first of all, does your school have any kind of skills framework which they use to encourage your students to develop skills? Like any common phrases that are used to explain skills or anything like that?

P2: Not that I can think of, no. I don't think so.

AW : Yeah, a lot of schools don't have that so.

P2: Yeah, scientific skills there was focus on that within the science curriculum, that seems to have even moved away slightly. But I can't think of anything across the whole school that we, I hope not because I don't think I am if there is!

AW: [Laughter] So when, in your own words then, what were the main skills that you saw students both years developing as they started to get on with the project?

P2: Definitely their confidence. Erm, their self belief which was lovely to watch. They were throwing their ideas around and someone agreeing with it, and building on it, and it happening that was lovely. And erm, one part of it, the kind of mood board thing that they had to create was great because you could give value to everyone's ideas. It didn't matter that you then didn't do it.

AW: Yes.

P2: You still got acknowledgement, and your ideas were displayed and potentially still talked about with judges, you know, so that was lovely.

AW: No that's really good, so erm, I hadn't really thought of the mood board of being a way of acknowledging people's contributions kind of at those early stages so that's really interesting.

P2: Yeah definitely.

AW: And which activities to do with the programme did you think helped them learn most effectively?

P2: Erm, they certainly when they knew they were going to have to do the boardroom [pitching their idea to judges], they really, the team that was working on that really got their heads together writing a script and who's going to say what. And that really got them focused definitely. I think the team leader thing gave them all an opportunity to develop their confidence and that's a really good way to keep them all involved as well. Yeah, and I think that all the ones who have done it are proud of themselves that they've stood in front and done our job for a bit.

AW: That's good. And obviously it's a bit difficult to say because school is very weird at the moment [due to COVID-19], but have you been aware of any of the students that took part using what they learnt from the Future Food Challenge to go on and do things, like, personally or in school.

P2: I don't know, I mean this year, I haven't been this year teaching any of my team from last year, so I've seen them round and things, but I don't know. And yeah, this year's team, I've just not really been seeing them so sorry.

AW: Oh no, that's fine, I really didn't anticipate that you would with everything that's been going on and not seeing people. Erm, okay, and were there any activities that they really didn't engage with and didn't seem to keep them focussed.

P2: Erm, not that I can think of. There would be times when some were more engaged than others but everything had a purpose to some of them, if not all of them. I can't think of anything that we were thinking, 'this isn't necessary', no.

AW: Right, okay. Erm, and did you find, I mean you got further with the programme this year than a lot of schools, so did you last year how much did you use the website, and how much did students seem to kind of, engage with that? They didn't have individual logins last year, so was it just mainly the slides that you used?

P2: Yes, the slides and the links and things like that.

AW: Yeah, and I know you didn't have much time this year, but in the short time that you were doing it, did students seem to kind of understand that the platform was more linked to the programme and that they'd be able to log on themselves? Or did you not get that far?

P2: No they did yeah, and I, after one week they went home and were all testing their logins and things and they were working and things. And I think only late on did I get them using their own login when they were team leader, I was still logging them onto

mine. That new platform is brilliant, to be able to see, like I said earlier, there were loads of things in it that were opportunities, but didn't have to be done and it made it so clear for me as well, to make sure, this is what we have to have done. Because you get to a point around 4pm as well where some of them are saying 'I need to go, I've got to get picked up in 15 minutes' and you go 'well okay we've got to do these, and anyone who wants to stay can stay and we'll carry on with the other stuff' or whatever, so yeah that was brilliant.

AW: Okay so with this, thinking about both teams actually, now that they've got individual logins and they can go on it on their phone at home and things like that. With all of the surrounding content that you don't have time to cover in the lesson but is there for context or extra skills development and things like that, do you envisage the students actually going away and doing that?

P2: Oh it's frozen I don't know if that's yours or mine..am I back?

AW: Don't worry that was mine as well.

P2: I can't remember where you got up to sorry.

Abby: That's fine! I'll say it again. So with this year, now having a platform with the individual logins and you were saying about the surrounding context and skill development material

P2: Right yeah.

AW: That you didn't have time to do in the lessons understandably, erm, do you envisage with either team or both teams, the more that that was highlighted on the platform 'this is something that you can go away and do on your own', do you think the students would go away and do that on their own?

P2: Yeah, I think that some would, not all of them, but I think some would yeah, and it would just be us dipping in to the right extent in the lesson to get their interest and then saying 'you can do this'.

AW: Yeah, yeah that makes sense. Erm, okay, and how did you feel that, do you feel that the programme contributed at all to your continuing professional development, did it have any impact on the way that you looked at your teaching or?

P2: Yeah, yeah.

AW: In what ways?

P2: I think again, what I mentioned earlier, up until that point the environmental that was, the classroom was really a curriculum point and we'd do it there, and I didn't necessarily look for those links elsewhere.

AW: Yeah

P2: You know, there was occasional discussion in class but it's definitely made me more aware of that. But I think -

AW: Yeah.

P2: There was something else... oh yeah so on the back of doing it last year, I was asked in school to go on a careers lead course and now I'm going to be a careers leader and give sort of the science part of it, so yeah loads! Loads has come of it for me! Definitely.

AW: Oh that's good, I'm really glad. Erm, and how successfully with, we're looking at the moment at doing a bit of a shorter summer course that's available for students and with social distancing we're having to look at a lot of ways that we change the content to be a bit more online, how successfully do you think that this type of programme can work remotely?

P2: I think it could work remotely, I'm wondering how many are going to sign up remotely. I've already sent Farm Urban's message to all our year 9s and 10s, and the head put it in his newsletter, he's doing like weekly newsletters. But I wish we had that chance in school to say 'listen, there's this thing you can do and it'll be great', then I think it would be great, but I just think getting that message to them that it's there is the hardest part really.

AW : Definitely, especially amidst all of the other information that they're getting about school as well, like it is difficult, definitely. Erm, have you got any other suggestions around the programme in general, what you would like to see developed or what we could capitalise on more or anything like that?

P2: No, I think it's brilliant. You know doing the workshop for everyone as well gives them a chance, because everyone who signs up generally is interested in these issues any way, so it's great for them to be able to develop on it, but the workshop exposes some to it who maybe weren't interested in it, maybe didn't have a clue. So erm, I love that it's that, it's both, it's building on something that's a real interest for some already for a smaller group of students. I can't see how we could facilitate it for many more, erm, without sort of diluting what they're getting. You know, it's so intense and I think that's brilliant. That's a real strength of it that if we up the numbers... I don't know I suppose if more staff and things like that but particularly when they break away into their teams there's only maybe five of them and they have to get involved, they really have to be into it, and want to do it, and that's brilliant. But yeah, then having the workshop and even the talks! The talks are brilliant, like I said that's what got me, it wasn't something that I'd been looking for or read about previously, so I think it's a really broad thing that reaches all on different levels I think it's great.

AW: Yeah, and do you, because a lot of the team are from Merseyside, do you think that that has an impact on the way that students engage with it, kind of knowing it's a local project?

P2: Possibly, yeah I don't know is the answer, I suppose the fact that they've seen you guys and Paul [from Farm Urban] comes in and says to them 'I started this myself'

that impresses them. So maybe that would be lost if it was other people coming in slightly, but other than that, we talked about where you are and I suppose they've been in, but I don't know! If, like, maybe more to me, maybe more to older people that it's a local thing, and I think you become a bit more aware of supporting local businesses and things like that, I don't know how much they, if they were still able to have the same interaction with someone coming up from London or from Edinburgh maybe they'd still be as enthused by it.

AW: Yeah, and do you, how do your students kind of respond to, have you got any awareness of if prominent characters in environment education are spoken about like Greta Thunberg or David Attenborough are spoken about. Do you students seem to have a knowledge of those people?

P2: Yeah they do actually generally yeah.

AW: And how do they respond to people like that, do they feel inspired? Or not very interested?

P2: Erm, I think largely inspired. I've certainly not heard them talking negatively about them if they come up, I've not really heard much negative chat, if anything it's positive. I suppose some are a bit kind of of elusive to it.

AW: Yeah, that makes sense. Erm, and a lot of the questions we've covered already really, erm, but do you feel that ultimately what you said at the beginning about wanting students to get out of it, and for you that was largely to catch that excitement about the programme, do you feel that that was achieved through the programme?

P2: Yeah, I think that particularly competition day just brings it all together so well, not even because they won, they enjoyed the day anyway, erm yeah, I think it does.

AW: That's great. Erm, finally then erm do you feel that if Farm Urban provided other modules that weren't the full Future Food Challenge but other kind of information and resources about the environment, do you think that those are resources that you'd be able to use in other lessons, with other year groups and things?

P2: Yeah, yeah definitely. I think there's so much scope for bringing this into other parts of the curriculum. I mean I only think about it in science, but I'm sure, you know, in the other subjects as well, geography, history, languages like, there's room for it anywhere definitely yeah.

AW: That's really interesting. Well that's all the questions that I erm wanted to cover really, I think the final thing for me is just erm, when you're teaching and when you became a teacher and then how you got on with being a teacher, what are the things that kind of personally motivate you to keep going back to school, and to keep seeing the kids learn more?

P2: It's quite interesting because I've thought about that quite a lot lately actually, because I think, sort of, with the chat about home schooling as well, you know, she's only in year 1, but I'm in a whatsapp with people from her class, and lots of them, we

haven't had much from her school. And erm, I'm alright with that. And I feel like I'm becoming, the actual knowledge education part is becoming less important to me, and more the how to be a good person. And things like the environment and the global I don't know, issues, situation, tolerances, you know, obviously education is important and I still enjoy teaching that and the knowledge. But I just kind of feel that there's so much else, particularly at secondary school they come in when they're 11 and they leave at 18, I mean they're adults. I want them to leave as reasonable adults who know how to treat each other. I'm finding that more and more of an issue. I don't know if that's because I've had children or having met children with issues along the way in my school and stuff, and thinking 'yeah, what we're teaching is a great skill for you to have but there's other stuff that you have to know'. So yeah I have had quite a shift on it actually.

AW: Yeah, that's really interesting. And I think that I've definitely seen that in different areas and different people, and I think the way that I think about education as well, erm, so kind of, with working with Farm Urban but with all the developments over the last year or so, and then recently COVID-19, it does give you the chance to reflect on what you want to achieve.

P2: It does yeah.

AW: Well that's great, and that's all of the questions I had for you so thank you so much for -

P2: No problem

AW: Spending the time with me, that's really, really helpful.

P2: It's lovely to see you!

Appendix 4: Participant 3 teacher interview

Interview 3

26.6.20

Duration: 1:06:10

AW: Mainly the whole context for the research is I'm looking at what environmental education looks like in schools, some of the motivations behind actors involved with education, so the kind of, Department for Education, the teachers unions, individual teachers, the students themselves, just various people to look at what they think about the environment themselves, how much of an important issue it is to them personally, and how that comes into schools. And then using that type of information I can make recommendations to Farm Urban about the way in which they want to develop their programme in a way that's in partnership with other people and also find any gaps and try and fill them. So I was firstly interested in what motivated you, how did you hear about the Future Food Challenge, and what motivated you in thinking it was something you wanted to be involved with?

P3: So how did I find out about it? I found out about Farm Urban from Countryfile, so I watched them on country file, and immediately followed them on social media. I contacted them on email and said can I bring my kids on a tour? Back then it was just on the roof of the Guild [at the University of Liverpool] and because on the roof of the Guild there are large pipes running between the tanks, they said, well firstly there wasn't a lift up there, and secondly the roof was inaccessible for wheelchair users, erm, so that then became a no no, but the more I followed them, I have to say that up until I was offered the opportunity for the Future Food Challenge, I hadn't heard about it.

Having known that you'd run it one year previously, erm, and then I think that I must have signed up to some sort of email list at some point. And erm, I suppose this feedback isn't fantastic because it doesn't seem like I was targeted personally, I think I saw it on twitter and thought 'oh that sounds great' so I sent an email and gave the information, and I think I got an email back to say that all the places had been taken, however, I'd obviously given a very good sob story in my email [laughter] and it was Jayne who emailed back and said 'we're going to fund it ourselves, you can definitely take part, this sounds really, really good, you know, we're really interested in the SEN department, you know, er, SEN wise and wanting to make sure we're inclusive erm, so, that's how I found out about it. I suppose what you could class that as stalking. I followed them on social media and wore them down until the point they said 'yeah you can come' [laughter].

AW: [Laughter] That's fair enough. And what was it about the programme that made you want to stalk Farm Urban?

P3: I think, I think what I wanted was some validation that what I know to be true is what other people are saying because sometimes I feel like in school I am fighting a losing battle. Erm, with environmental stuff and switching off lights and computers and screens and recycling, and not using the plastic cups at the dispenser anytime anyone wants them, and I, I do understand about aquaponics, I understand about

hydroponics, I understand about creating food sustainably, I really, really understand about plastic, and I am hugely, hugely aware of air miles. So I suppose partly it was of interest to me, because I wanted to know more about what we could do. I suppose because at the time because when I asked it was inaccessible for us to be able to visit, I thought well if we could go and visit that would be great.

We have a huge focus on employability at our school, erm, only 4% of people with disabilities nationally are in full time paid employment, so we are doing as much as we can to prepare our children and expose our children to the labour market and what goes on in the world of work, and how many opportunities there are for them. Because their entrance into the economy and possibly feeding back into society, with taxes and what have you, are very different to what ours looks like, and obviously they are going to need a little more support, and a little help, and what they will do will be slightly different than what we would do. So I suppose a part of it for me was that I really liked the employability side, and I really liked the business side of it, and even though we made accommodations for, obviously, the fact that our kids weren't mainstream.

I liked the fact that it was something I was passionate about because I feel like if you aren't passionate about something and it's not something that you're really interested in, and you just want something that's free, or that someone's going to organise for you so you don't have to do your lesson plans, I think you're going into it with the wrong mindset. But I do feel like excitement is contagious, and I think that erm if you're not passionate about what you're teaching about then it's going to fall on deaf ears, because they're going to know that you're not interested. So I suppose it's a mix of wanting to do something that was so wildly different than anything I could possibly deliver in the classroom under normal circumstances.

I liked the employability aspect of it and I liked the business, and the marketing, and the planning and even though the children were highly supported and even though they needed support at every stage, and we weren't able to run it as a linear fashion that everyone else did, potentially, they all contributed and they all had their voices heard. And even if it was just something like 'right, this arrow that's going around our logo, can we do a vote on that please' because everybody had colours in their AAC [augmentative, alternative communication] system, everyone had the capacity to be able to make a choice, and everyone felt like they were an equal participant in the contribution and the creation of that logo. So even if that was the only thing that people contributed in the twelve weeks, they felt like they were a part of it. And obviously they contributed in other ways as well, erm. So I suppose the employability aspect, the fact that it was really interesting and the fact that there's no way that you'd find that on a national curriculum subject anywhere, I'd say that's what drew me to it.

AW: Yeah? How would you feel about... through my research, I've been reading a little bit about erm, the 'national framework for sustainability in schools' which was introduced in the nineties, and by the end of the noughties was done away with. So the original plan was for Ofsted to monitor sustainability in schools, both teaching it and also making buildings more sustainable. But by 2009 it just got ditched as a concept in schools. So it's my understanding from the research, and there's a memo from the Department for Education saying 'here's some tips for schools exploring

sustainability in their lessons if they wish to, but the emphasis very much seems to me to be on the schools to take that up that agenda themselves...

P3: 100%, I've never heard of that and I've just written it down so that I can google it after this meeting. And I'm not going to say that I'm like, the best person to do with the environment or anything, but I'd like to think that I'm quite well informed, and I never knew that was a thing.

AW: Yes, I didn't, until about, not long ago when I discovered that because it seemed to me like quite a coherent programme...

P3: What was it called?

AW: The national framework for sustainability. And so I was wondering if there appeared to be any vestiges of that type of agenda left in schools, but you don't think that?

P3: Not at all. I know that within the geography curriculum for national GCSEs and A levels, they focus on you know sea level rising. But I think that unless you, there needs to be a systemic change within curriculum planning. My parents for example always say that my sense of direction and geography is always shocking. For example, if I'm going to Coventry for the weekend and they say 'do you know what road you're going on' I'll say 'no I'll use the sat nav', I'm different than that now but when I was 17-24 I just plugged in the sat nav and went, but they'd say 'but you did Geography, why don't you know where Coventry is? Why don't you know that you go on the M... you know that type of thing, but, and the pure and simple reason for that is that during my geography GCSE we focused on the GDP of countries, we focused on population, we focused on sea level, erm contours, we focused on sea erosion, on the difference between a chalk cliff face and a sandstone cliff face, you know, we didn't do anything about countries, where they were, what their population are. Capitals of countries, flags of countries, zero knowledge. Absolutely zero knowledge. And I don't think the curriculum has changed that much in the fifteen years since I was doing that.

And I do think that there is a push for sustainability, green schools, to be at the forefront, but until it's in legislation and it's a white paper and people have to start doing it, no one will do it because everyone's got a million other things to do. And you know, there's the Eco-Schools erm organisation which is absolutely fantastic, I tried to start it in our school but it got swept under the carpet because people said that there's not enough time to do it because there's not enough time in the school day as it is. Little things like monitoring how many times people turn the lights on and off during the day, people were not willing to give me the information because they knew I'd shout at them! So I think that a framework for sustainability is something that would be really great to bring back in, because even if every single school, if there were like twenty things you can do, even if every school only did one of them, we'd be better off. Erm, but I am happy to admit I'd never heard about it, and that's not good. That's not good coming from an educator.

AW: I mean, it was a government policy that was in place before the Department for Education was even formed, so I don't think, I'm not anticipating that a lot of people

will really have heard of it erm, but I just think it's interesting that that was something that existed at one point, and doesn't now, and when you said that you think that there is more of a push for sustainability in schools now, who do you think the primary people are in pushing for that?

P3: David Attenborough, Greta Thunberg. Just hang on a second [produces cardboard cutout of David Attenborough], [laughter] I won this at Bongo's Bingo and this is the best thing I have in my house!

AW: [Laughter] That is absolutely incredible, I'm very jealous.

P3: As you can see how far away it was from my computer, this is my dining room, this is my classroom for the moment, I've got a whiteboard set up over here for doing writing during lessons, I'm not going to show you the rest of the table, but it's a 16 seater dining room table and there's just about enough room for these post its in front of me, there's shit everywhere, erm, but David Attenborough is never more than an arm's reach away from me at any time. All the other things I might take some time to find but I know where he is at all times. He came on all the climate marches with me, erm, he comes to school with me regularly, I've got a cardboard cutout of Tim Peake on one side of my desk in school and David Attenborough's usually on the other side. Er, yeah. So I think that Planet Earth and Blue Planet Two, I think that Blue Planet Two has been the catalyst for a lot of things.

I think that, wrongly, green washing has become something that brings it to the forefront of people's minds because they think that they are doing the right thing unless they're told otherwise they really, truly believe, I'll buy this because it's the best thing to do. Erm. I think that it's unavoidable to know what your impact is to the environment now, and whether you choose to act on it or do something about it is very much up to you. And whether you act on it or brush it under the carpet and say 'I know about it'. I always think it's one of those things you know, if you say you don't know then that's fine if you don't know, but as soon as you do know, there's really no excuse. Erm, and that can go for anything. That can go for animal abuse, that can go for adopting a child from China with a multiple disability, and that can go for anything about sustainability, the environment, plastic, conserving water, you know anything like that.

I was just having a conversation today with some people in school, so learning support assistants in school who I feel are quite ill informed about most things when I talk to them. I was talking to them about the UV warnings that we've had today, and their reaction to what I've told them was 'oh right, so we should probably all start going on holiday again' and I was like I mustn't have said this correctly, I will rephrase what I've just said because what I know is this, and what I was trying to portray to you was that unfortunately, because we're not travelling, and there's less pollution in the air means that the UV rays can get through to us quicker and means that we can get burnt more easily. So isn't that great, that because there is such little pollution in the air, in the air that we're breathing, that the UV rays can get through to us, and isn't it wonderful that we have to worry about being burnt rather than the smog that we've created through combustion engines being the thing that shields us from the sun's rays and they just did not get it. At all. And I think that education, unfortunately we are talking about education, and I'm saying that I don't think that

education is working, I think that any education through any form other than formal teaching. Erm I don't think that, I know some people do general studies, some people do citizenship, I know that some schools do sort of, you know, a humanities erm GCSE and A level, and if you do a humanities GCSE or a humanities A Level, you're going to be focusing on the Romans and the Tudors rather than what water levels were in this time, and not only looking at the industrial revolution, but looking at the industrial revolution and the changes that happened and how beneficial that was at the time and how much money they made, and how much quicker they could get things from A to B, about how inefficient it was to the environment. And I don't think, I think that every single topic in school, every single topic in every single lesson, it can be weaved into it in a very subtle way erm, and I don't think that, I'm very, very sad to say that I don't think that will become legislation or something that's enforced.

AW: Yeah. Do you, I was reading recently that out of the climate strikes, young people have an organisation called 'Teach the Future'

P3: Yeah

AW: And they talk about a lot of the same things, and I hadn't heard of them before, but they're calling for a lot of the same things that you are asking for. And their demands are a review into the education system -

P3: Umhm.

AW: And CPD for teachers for teaching about environmental issues but also about managing eco anxiety in their students -

P3: Yeah!

AW: And also finally a piece of legislation to enforce this and also draw down funding for students who are wanting to do something to help the environment, erm and their point is very much the same, that this won't get done unless it's legislation, when there's the choice it's just not getting done. How do you feel about the amount of pressure that's on teacher's to meet certain targets, and you said a lot of the teacher's had fed back to you that there's not enough time in the school day and things like that. How do you feel about getting the balance about how important it is for students to know about the environment compared to how much pressure is on teachers already?

P3: I mean, erm, the way I look at it is, if we don't teach the children about how to care for the environment there's not going to be a future for them to be into so I feel quite strongly about that. And the way I talk and the way that I plan for things, all those words that were put into that symbol software by Tobii Dynavox and Boardmaker. The accompanying blog post that I did for the launch of those words was, you know, this is now bread and butter, this is what people talk about all of the time, and it's important that our young people are able to access those words and use them in a novel message when they've created them. But I don't, I suppose the best way of getting some really, really interesting data about this would be if you did a cross section of all teachers, like if you did all teachers in my school they'd probably all say 'yes the environment's very important' because they'd think 'oh shit P1's

going to check up on me if I don't say this', but erm, equally they'd all say the right things but it's the difference between saying it and doing it. And it's the difference between saying that you understand that the environment is important and understanding that sustainability is important, and understanding that, you know, erm, not wasting water and all of the things that we're trying to say is important, and having that at the forefront of their mind and in everything they're doing, and everything that they're teaching, because it doesn't need to be a six hour lesson. It just needs to be in the middle of your teaching, just one comment.

AW: Yeah. I think that's interesting as well because the students, in their list of demands, on one of the things that they mentioned was about the idea of their subliminal education -

P3: Yeah.

Abby: And it's all very well being told in one context, in a lesson, 'climate change is a problem, humans are having an impact on the environment' but unless they're subliminally seeing that in the behaviour of their teachers and their school and the space that they're looking at and things like that, that it's not going to sink in as an important issue, is kind of what I was getting from what they were saying.

P3: Yeah, yeah. I think that the point that you made about CP, the kids... I mean you're looking here at children informing policy for adults to then teach back to them which is a disgusting way for the world to be at the moment. It should be that the people in positions of power are putting things in place that are relevant and useful to those young people. And our young people should be concentrating on, I mean I know their generation is different to what mine was, like I was concentrating on my Nokia 3310 and my see through pencil case. Whereas they're concentrating on Tik Tok and Snapchat and filters on their faces and things like that, which I think that kids are growing up far too quickly these days.

I don't think that, I really, really, strongly feel like it shouldn't be down to children to have to be petitioning and marching, and although I go along to every single one of them, when I look at children there who are not at school who are at a climate change rally, it is so incongruous to me as an educator that these children should be missing education to get their point across. Erm. I don't think it's right at all, I just don't think they should be doing it, they should be in school, be safe, and just be kids. And as soon as you start to have any form of strong opinion on anything, you lose the right to be a kid, because once you've stood up for something that you truly believe in, you can't go back to being an idiot, because people will think too much of you and people won't take you seriously if you ever have something more important to say. And I think that it's a really, really sad state of affairs that kids, school age children, are informing government decisions because it shouldn't be that way round it should be the other way. But then equally, when we're looking at sort of co-creating curriculums and we're looking at making sure that the things that we're teaching the children are relevant, pupil voice should be quite high erm, and we should be saying, not necessarily what do you want to learn because you can't ask someone at the beginning of their GCSEs 'what do you want to learn in this science topic for the next two years' because they might think of things completely off the wall that aren't going to be on the exam.

So in some respects teachers hands are tied by content and curriculum, erm, which are going to be assessed. And of course, GCSEs and A levels are the pinnacle of what you're working towards, but those, your lessons inform all of them, all the way down school. So even when you accept a four year old child at nursery in, you know, September 2020, you're not thinking about erm, July 2036 when they're doing their GCSEs, but subliminally you are, because everything you do will build to that, so even when you're saying sort of, primary school doesn't matter, let's think about secondary age children when you're starting in year 7, you are already working towards the GCSEs. So if you aren't thinking about building the blocks that those children need to be successful to pass GCSEs which let's face it what does it matter? If you pass a GCSE it doesn't necessarily mean that you're an expert in that area it just means you know how to pass an exam. It's a little bit like knowing how to pass a driving test and being a safe driver.

AW: Yes, yeah.

P3: Erm, I suppose if we look at... the only way to make any meaningful change, would be to include some form of green futures topic in a number of the GCSEs and A Levels, you know it can be included in history. Because you're looking at history and you're looking at what we have done five years ago, ten years ago, twenty years ago, one hundred years ago, and then you're using those figures to predict what it could be in the future so you could be looking at geography, a part of history. Biology, chemistry, physics - obviously very relevant. You know, we can bring it into English, we can bring it into English literature. Erm, I'm looking here at Greta's story, 'No one is too small to make a difference', 'Earth Heroes', 'Plastic sucks', 'Somebody swallowed Stanley', 'T-veg', what's that one, 'Lottie's Dragon', 'This is not a drill', 'It's your world', 'Fantastic women who saved the world', 'The planet's too hot' all of those fantastic books within arms reach of me right now, erm, all of which could be used, you know 'No one is too small to make a difference', that book about Greta Thunberg's speeches could definitely be used in the English literacy curriculum, erm, could be included in the Swedish curriculum too if anyone learnt to speak Swedish! As eloquently as she speaks English which is embarrassing! So great isn't she?

AW: She's amazing yeah, so inspirational. So, when like, with all of that in mind about the environment, what were you hoping when you started the Future Food Challenge? What were you hoping the outcomes would be from the programme?

P3: I hoped that - given that we already had fish in the classroom anyway, I hoped that people would see them as more than just pets, I hoped that people would see... for example this afternoon I have got this filter, thing on a tube and probably once every month we do a massive clean out of the tanks. Clean the windows, clean the gravel, clean the filter, we probably don't do it as often as we should do but you know, time constraints, and every single time I'm sucking out all this poo and the water is coming out and I'm thinking 'God that's such great nutrients'. And I've known it was such great nutrients, but I only knew that because I knew that, I didn't know that because anyone had told me. And when Paul came to do his TED talk and spoke to the children, he was like 'oh you could definitely turn any of these into one, and I was like 'really? I had no idea!' erm, and the only background knowledge that I

had was what I'd seen on countryfile and what I'd seen on social media. Albeit if they posted any further reading or 'watch this video' obviously I followed those links.

So I suppose what I was hoping to get out of the Future Food Challenge, in addition to the things I mentioned before for us personally, with regard to the curriculum and the outcomes for our kids, and exposing them to all sorts of different things which I wouldn't ordinarily be able to do, was, I suppose in a really, really selfish way I was pushing my own agenda. Which, which you know, we're in, I'm in a very, very powerful position, in that I very regularly, sorry, very irregularly, do I really contemplate - and the reason that I don't is because I'd get so stressed out I'd stop thinking about it - contemplate that how influential I am on those young people. Erm and that everything I'm saying throughout every single day, you know they're just little sponges and they can take everything in and they can listen to it, or not. Erm, and I suppose I wanted some validations and verification that someone else coming in and saying the things that I'd been saying. It's always that thing of if someone else says the same thing you listen, you know, your parents say it and you don't listen and what have you.

Erm so I suppose it was something that I was interested in. I thought it would be really, really interesting, I thought it was something that was so brand new that it would make us all stand up and pay attention rather than become stale. I've never subscribed to this, but erm, I once I did supply teaching before I got the job I'm in now. The job I'm in now was my second paid contracted job, but I did supply for five years before I got those jobs because I just couldn't get a job. And erm, I covered for a lady who had broken her ankle in the snow in January and I walked, I came into the school half way through a term, and then February half term came and I went to the people next door and was like 'where's the planning, what's the scheme of work'. And they were like 'oh she always does the fire of London spring 2' and I was like 'Oh okay then, and she had this massive walk in cupboard, and it had six boxes - autumn 1, autumn 2, Spring 1, spring 2, summer 1, summer 2, and she did the same topics every single year.

Because she was a year one teacher, and because she doesn't do what I do, which is sometimes keep the children, sometimes they move on, she literally had six topics which she had honed down to a fine art, and there's nothing wrong with that, you know, if the wheel ain't broke don't fix it. But at that time, I was like, how sad that she cannot, not sad... yeah sad, that she has, is so prescriptive in what she's doing that she has no way to deviate from what she's, and if for example, it was the term when the giants had come to Liverpool, would she have continued to teach the great fire of London? When they were in New Brighton? Is it not more relevant to talk about what the children are talking about and really, really concentrate on what they're interested in, and follow that child's line of interest. You know, some days I come into school and I've got, you know, three lessons, lesson 1 and 2, lesson 3 and 4, lesson 5 and 6 planned, and we watch Newsround in the morning which lasts all of 6 minutes. And sometimes one thing which has been a thirty second news story, can pique the interest and spark a conversation which means I have to then turn everything I was going to do on a sixpence, and we spend an entire day.

One of the days I was going to do, I specifically remember, was the day that the last Black African Rhino died, and it was on Newsround and you know I did hammer it

home, 'isn't that sad? How do you feel about that? Would you like to be the last person left on earth of our species? Isn't it sad that people have to carry guns to look after him? Do you think he wanted to die? You know just chatting away, chatting away, and they all started talking about it and were all really interested in it, erm and I have the flexibility to be able to do that because I don't have, you know, national curriculum raining down on me, but erm, so I suppose that I wanted to do the Future Food Challenge because, it was going to be something that was so out of the ordinary and something that I knew that no one in school would have ever done, that it was so new that everybody would find it really interesting. Because there's something that is out of the ordinary and something that is usually out of the mindset, so far removed from what we usually do, that people would have no, no, they wouldn't have the opportunity not to listen.

AW: Yeah.

P3: That might be the wrong way to go into it, but the staff learnt so much. My staff learnt so much, and my staff are really on board. They listen to me, they ask questions, I get texts at 10.30 on a Friday night saying '[P1], can this go in my recycling bin?'. That's fine. That's fine by me, erm, so I suppose I wanted, we all wanted to learn. There's things that I learnt and you know I did my research and I learnt what we needed to look at and sorted out 'I don't know what that is'. A big part of being a teacher is you have to know, you have to always be one level ahead of the kids, because you can't teach something that you don't know about yourself, so I thought it would be interesting and we'd all learn something, and it was! You know it turned out to be absolutely perfect. It ticked all the boxes of all the expectations that I thought of and more. When I thought it's going to be educational, interesting, all these lessons are already planned out for me, I just need to adapt them for me, because at the end of the day if you give someone a blank sheet of paper it's hard to think of something, but if you're given something where it's like all the other six schools, you make that fit your kids, and it's definitely easier to do that. You know, the resources were fantastic, it was flexible in ability and time. We didn't stick to the 'do this in ten minutes' it might have taken us an hour, but we did it!

AW: That's really good to hear. So what do you think was the most difficult aspect of facilitating the challenge?

P3: I suppose for me, I suppose the facilitating part for me on a personal level was relinquishing responsibility. Because when we got to the point where we were splitting into teams, I knew that I was the one with the background knowledge of this and I was sending members of staff away to lead a session for something that they had no overall knowledge of.

AW: Yeah.

P3: And I appreciate that what you were planning on doing was allowing year nine children to lead on that thing, but the amount of time that the staff had to invest in being prepared to be able to lead that wasn't as much as you would have expected. So at the end each week you said 'you're going to be the leader of this next week, you need to do this, this and this to prepare yourself', whereas I was the leader of all of the weeks and I was like 'marketing team go and do that and I'll be with you in ten

minutes, this team go and do that and I'll be with you in twenty minutes, and I'm going to work with this team for ten minutes, and I'm going to set this LSA [Learning Support Assistant] off, I'm going to give everyone the overview of what they're doing'. So I guess we're in a very unique position and I'm sure, if you are interviewing all of the other teachers you will, they'll have different, but for me personally from an SEN point of view, from the fact that I had four Learning Support Assistants and only eight children, but other people had 15 kids and only one of them, erm, the organisation of it was quite difficult because the baseline knowledge of it and the understanding for my staff was that I came to that training day, and I knew everything.

AW: Yeah.

P3: I needed to, I needed to share that information before they could go and do that. Time in school is very limited so even, we have 15 minutes briefing every morning. And you know on the days that we were doing that I would have probably driven into school thinking 'and I'm going to do that', but then something else came up like, you know, 'is the hydrotherapy pool closed, is this person going to physiotherapy, did this person vomit in the night, did this person have an epileptic seizure, are you on break duty?' Do you know what I mean? So all of the day to day management and the mundane crappy conversations that you have to have every day, like 'who's going to be on bathroom, who's going to be on drinks who's going on their break first, who's going on their break second, who's going outside with this person at lunch time, who's brought their swimming costume because apparently hydro is open, so someone needs to go and get in the pool'. So all that mundane boring things, that would have been the ideal opportunity for me to say 'this is what we're doing today, I want you to lead this team, I want you to lead this team, this is the background knowledge that you need to have, and this is the background knowledge that if you were a year nine child I would have given you so that you could confidently lead that'. But then again, that's not a slight on the Future Food Challenge organisational structure or anything, that, that, that's a problem of, you know, the organisation and the running of it.

AW: Well it's definitely relevant for, kind of, the more resources that get developed for that type of scenario, and if we're working with more SEN schools that's helpful to know.

P3: Yeah. And just as a, just as a heads up, I do have four new children joining me next academic year.

AW: Okay.

P3: So I'm still going to have four of the children that did it the first time round, but the children who were really, really influential were the children who were older last time, so will have gone into sixth form. So I'm going to have four year sevens, two year eights and two year nines. Whereas last year I had like, year 7- year 12.

AW: Yeah.

P3: So we'd be interested in doing it again, if there's space for us, obviously.

AW: Yeah, of course, that's great. Erm, so, what do you think were the major skills that your students developed during the programme? So like were there anything very noticeable for you that anyone seemed to, kind of, latch on to and you know then progress in a certain area?

P3: From my perspective, because my area of specialism is AAC and communication, everything that we were doing was through communication. So even if the outcome of the session was that we needed to have this done, we can't do that without communicating. So if you looked at the year 9 groups and the activities that they were doing, none of them would have sat in silence doing that, there would have been lots of collaboration and deliberation and who's going to do what, and what have you. So for me, [member of the class] being able to explain how aquaponics works was a huge plus. And I've actually used that video in conferences that I've presented at. He is a huge success story. So he occasionally just knocks it out of the park, and I don't know how it's happened but on a number of occasions, I've just happened to have been recording and those pieces of video evidence are just fantastic.

Like we used to have chickens in school, and he told one of the chickens to get down off his tray table once and it got off! And I got it on camera and it's just a really, really good video. And I presented that at a national conference in Leeds in 2018 and sort of used that as an example of how powerful using AAC can be cause you can even influence chickens! And everyone thought that was just wonderful, but it was just one of those videos where I was like 'I can't believe that's just happened' you know, if he'd have just said 'get down chicken please' and it hadn't had got down, it still would have been a fantastic video, but the fact that he pressed it and it got down was just wonderful!

So the skills that they learnt - I know that they all had a really, really good understanding and baseline knowledge of how aquaponics works, erm, they all have an understanding of you know life and death and living things, and you know. I always talk about oxygen because we've got lots of plants in the room and people always say 'oh you've got lots of plants' and I say, you know, there's PhD studies that show that oxygenating plants make people perform better, in the same way that I have rosemary oil in an oil diffuser. There were studies done showing that, I think it was PhD students in exams or something, it was definitely university students, and they erm, half of them had rosemary oil either, in any form and half of them didn't, and the half that did performed better on their exams, or got better results or whatever, erm and I thought 'right, that's what I'm going to do.' I know that my kids aren't doing PhDs, but the number one thing that Ofsted look for is having high expectations of the children, and if I can have oxygenating plants in the room, if I can have fish that keep them calm so they're able to regulate their emotions or any outbursts that they might have, if I have rosemary oil, diffuser because there is a recommendation that PhD people perform better in their doctorates, then my kids are worth me spending a couple of quid on a rosemary thing and it makes the classroom smell nice, it's fine!

Erm, so, you know, they had an understanding of what plants do, and they had an understanding of what fish do, and I had an understanding of what aquaponics was, but now they all have an understanding of what aquaponics is and I think that is really

beneficial. And erm, they were all really proud about their lettuce, and they were proud to be able to show it to people and at the end of the day, the ikea box, the ikea box, the original one, visually is very distracting. It looks like an alien spaceship has just landed. So by its very nature, it draws the eye, and everyone who came in the room who didn't know what we were doing said 'what's that?' and by doing that, it allows the children the opportunity to hone their skills of explaining what it was and by the end of it, you know, by the time we had had it in the classroom for six months, they had it down! People were coming in and saying 'what's this thing with the lights? What are you growing there?' and the kids were like 'it's fish, fish poo, fish poo goes up, into the roots, plants grow, feed the plants, water goes down, fish poo goes over'.

AW: Yeah.

P3: And I think their understanding of aquaponics was great. I don't think the marketing aspect of it was really, that didn't really hit us as well as if we were mainstream and had that cognitive ability. Erm, I think the sales aspect and the fact that they thought that we could make money on it. Because what we were going to do, was we were going to sell them to the kitchen.

AW: Oh yeah.

P1: And it was six of one and half a dozen of the other because the kitchen either buy them from Breaks, erm the catering department, or they buy them from us. The catering department they buy lettuces anyway, and the catering manager basically said you know, the school money, the money comes from the school budget, and the money is going to come out of the catering department and the money will go into the S1 budget so its either going to go to Breaks or to S1, the money's going to come out anyway. So they really, really liked that they thought that they could make money because I'm very, very into entrepreneurial skills, we've done lots and lots of things where, for example we bred some chicks once for one of our physios. She had some chickens and she said that they were getting toward the end of their laying life and she was going to replace them and she was going to go somewhere and buy some. But because we, because I'd hatched chicks in school for us, she said you know, 'can you hatch some chicks for me?' and I was like 'absolutely. What do you want?'.

So I sourced the eggs, we hatched them, we candled them, we looked after them. We worked out that each of them had cost us £2.50 to raise to ten weeks old, so we said we were going to charge her £3.50, there were 12, so we made £12. And the children said that they wanted to buy a DVD of something crap, like Despicable Me, microwave popcorn and some marshmallows, so that was their reward for all of their hard work of making sure the incubator was on, when they were hatched making sure they had food, making sure they had water, making sure someone cleaned them, making sure they had light and, you know, it's a very, very small way to look at entrepreneurial skills and enterprise but that's at the level that they could access, so the whole thing about you know selling, [member of staff] gave us ridiculous figures like I buy an iceberg lettuce for 13p, and I was like you're not going to get a lettuce from us for 13p, it's going to be more like £2. [Laughter]. But it's not going to be in plastic and it's not going to have any air miles and all of the children in school will probably eat it because they've seen it being grown, so we sort of met in the middle

and she was like maybe I'll buy one lettuce of you a week and I was like 'well we're going to have twelve' [laughter] but then we thought maybe we could sell them to staff, and the bottom line is important for individuals, maybe that's a way that we could do it. I suppose it's a bit of a cut throat way of looking at life, but the whole erm, buying and selling and purchasing and profit making was something that they all learnt as well. I think that they had a good grasp of that anyway, but you know it's always helpful to do it more. You can never be too entrepreneurial can you?

AW: No, and the concepts that you were exploring with them about, kind of, you said that you were getting the symbols for coral bleaching and various things associated with the programme like the actual aquaponics symbol. How did the children seem to respond to the environmental concepts that they became familiar with?

P3: I suppose my class aren't a particularly good study group, because I indoctrinate them all the time, I suppose another class in school would have been a really good benchmark for whether they, whether they understood concepts beforehand or not. Because my class knew that plastic was bad, so that was the in for me. I was like 'look at this lettuce that [we get] every week, we go through four lettuces a week on the salad bar, that's four bits of plastic a week. If we can provide the lettuce for her, that means that there's four less bits of plastic going in the bin, how do we feel about that?' and they were like 'yaaay'. Erm, so I suppose they liked the fact that there were the fish and they were our fish anyway we didn't have to go out and buy any new fish, they were just fish that were transferred from one tank to the other. Erm, they liked the fact that it was something interesting. They LOVED the building erm, they I mean at times, I think my class were all boys then? Oh no, [member of class] was in my class then, you know they really really liked DIY, they liked it when I brought in the hammer and the saw and all that. The other thing, is that our school doesn't have a DT Department, so all of the equipment that we needed, I had to look at in advance and be like 'Dad, do we have a blah blah blah, and do you have a tool kit, because I definitely want to take it in a tool kit so that it looks like we're getting tools out of a tool kit because if I just pull them out my handbag then that's odd'.

AW: [laughter]

P3: So that's, they really enjoyed the DIY aspect of it and they enjoyed the building, and I mean everybody loves building don't you because you start with a load of stuff on the floor and then you have something at the end.

AW: Yeah.

P3: Erm, yeah I think that they understood, I think that the environmental concepts that they understood were about air miles because erm we were looking at where lettuce, we talked about did we all like lettuce, that's where we started, and then, you know, if you like lettuce where is it grown, and if you don't know let's find out where it is grown, erm, and we found out that most of it was grown in Spain. So then we were like, 'well who has been to Spain? Do you know what language they speak? Do you know what currency it is? Do you know how long it takes to get there on a plane?'. And we're talking about, you know, obviously when we had grown the lettuce, when we'd picked it, and ate it, we were like no air miles and it hasn't been in a plane for five hours, and then transported for 12 and then sat in a shop for 2 days

erm I'd like to think that they understood it but I don't know. Retention is a big problem in our school, and with all people with special needs, if you don't keep going over something over and over and over again. It would be really, really interesting now that we've had this discussion, it would be really interesting for me to have this conversation with my kids and say you know 'what's this? What does it do? How is it helping us?' Yep. I might do that.

AW: Yes that would be really interesting. Definitely. Did you notice any of the kids' relationship with salad change? Like you might not have seen, but did anyone who wouldn't go near salad in the beginning start eating it?

P3: Yes. So we all did try the salad, and we all, and I've got a couple of children who are, I was about to say nil by mouth, but don't eat, they can eat, they just choose not to from autism. Erm, so we all tried it and even when we got to the point where when you're doing that baby led weaning and you're just letting children throw stuff on the floor, and I'm always watching those programmes like 'that is such a waste of food, that is such a waste of food'. But we were picking lettuces that we had painstakingly grown, and they were like mushing them in their hands and I was like 'that is such a waste of a lettuce, home grown, not in plastic, no air miles, the freshest lettuce you're going to get' but then I thought 'that's where they're up to and they're probably not going to put it in their mouths and they're probably not going to eat it, but they've got it in their hands and they've, you know, maybe they'll put their fingers in their mouth in a little minute and get some vitamins, erm, [laughter] I don't know.

But we did all at least have a go at using all of our senses, of smelling, and licking and feeling. We did some, like, pencil rubbings of the veins on the back of it. We used it for a really nice stimulus for a lot of art lessons, and looking at those types of things erm. [Member of class 1] and [Member of class 2] are my two that don't eat anything out of the ordinary, they know what they like and they only eat that. But erm, I can't remember if they ate anything or not. I think [Member of class 2] definitely put it in his mouth. I don't think he swallowed it, but [Member of class 1] steadfast refused. But he was absolutely 100%, he had the investment into the fish, the investment into the water, checking on it, erm, he was was the first person that told us we had greenfly on them, erm, because they were right next to the door and I think something must have flown in one day, and over the weekend, erm, we just had this infestation on like three of the lettuce.

AW: Yeah.

P3: Erm, and he was like 'come and look at this [P1] it looks strange' erm, so he was very interested in it, regardless of the fact that he had absolutely no inclination to eat lettuce in any way shape or form [laughter].

AW: Yeah. Oh that's really helpful, thank you. Erm, so how much on the technology side of it, just kind of the slide show and the online platform, erm, obviously you haven't, I don't think that you've seen the new online platform that we've got yet? Have you, I'll have to send you a link so you can have a look round it because it's really different and I think you'll like it. But having those online resources, and having the website as like a host for those resources how did you find that? Was it helpful or would it have been fine in a different pack?

P3: No I loved it, I thought it was really, really good. I know that on some days when I was losing the will to live on something or other else, I was like right, this afternoon we're doing the Future Food Challenge, I know we did it on Monday and it's Thursday, but you know it's a 12 week programme, and it takes us longer anyway, so if we have to pick it up, and I was like, right, I know that we can dip in and dip out that. I know that we don't have the time limits that everybody else has because they're either doing it in a lunch hour or an after school club, and I know that we have the flexibility to be able to make this last longer. But I, the only problem that we had, which is a really really minor one, was that the children's laptops because obviously I did the main one on the computer with the big screen, and then when they had to go off and split into teams erm, we had to get it unblocked from the technician because the kids laptops and the kids laptops accounts are like so, clamped down for security, but other than that I thought they were really, really helpful. And, I sort of wrote down all the usernames and passwords and we had them twice and I'd just give them to one member of staff, one member of staff and just say 'start on slide 57, you start on slide 62'.

AW: Yeah.

P3: And it worked really well and I thought, there was nothing more I could have added to it so if you've added more to it and you think it's even better then it must be wonderful!

AW: [Laughter] well that's good. So did you, I was reading about the government's EdTech strategy, so just last year, releasing a strategy to say that we needed better IT infrastructure in schools and for kids to be able to use technology to aid their learning. Do you feel that, I think in my experience of the Future Food Challenge, there was quite a lot of problems with literally accessing laptops and things, but I know that a lot of your children already have tablets that they use for communication so it's slightly different because of that access. But how do you feel that your school in particular kind of deals with EdTech devices and do you think it's readily available or do you think there's barriers to using it or?

P3: Erm, I mean in school we have everything we need, but this pandemic has highlighted to us the lack of technology available to children at home.

AW: Right.

P3: Erm, so I put a grant application in for the fourth or fifth week of lockdown, put a grant application in for 15 laptops. Erm, we were successful with that, so then I had them all set up by the technician, she put bookmarks on for everybody with all of the websites that they needed to erm access and then I went and delivered them. Some people were very grateful and they accepted it, and said that they would be able to connect it to the internet and they would be able to log on. And for some families I was standing outside their kitchen window for over an hour trying to describe to them how to use a trackpad on a laptop because they just had zero access to technology. And I suppose that adults who have zero access to technology then raise children who have zero access to technology, it becomes a self fulfilling prophecy doesn't it?

Erm, I think that of the children that we've given laptops to, probably over half to three quarters of them have accessed the things we asked them to access, and that they just needed a physical piece of equipment in order to do that. Erm, some of them haven't but then you can lead a horse to water. Erm, certainly within each room we have a laptop for every single child erm, and with regard to you know personal computer systems, those are funded through the local authority's education and health department, through the CAAT team [Communication, Augmentative, Assistive Technology] or from the ACE Centre in Oldham which is a specific charity whose Monday to Friday bread and butter is procurement of AAC [Augmentative and Alternative Communication] devices for children. Sorry anyone, children and adults. So I think that we're in, we're in a, a unique position that we're pretty well served for computers, and accessing laptops wasn't a problem for us, erm but I can see that in mainstream schools where in that classroom there is only the teacher's laptop and the screen, erm, people bringing laptops from other places may have been a difficulty. But for us, that wasn't an issue.

AW: Yeah. And was there any way that because of the way that the children use technology already, obviously a major, major thing that came out of your programme was getting the symbols on the tablets to express ideas. Was there any other way that you thought about technology, like, as a potential for delivering the content in a different way? Like was there anything that you thought 'this would be good if the kids could do this on the computer'?

P3: Hmmm. I don't think so. Erm, no I don't, I mean, from my perspective, from a geeky perspective, there's obviously loads of things that technology could of helped us with, and when I saw the extra things that you might want to do every week I thought 'oh that's a cool one' erm, you know, like looking at how much daylight they have and the nutrients in the water, and doing a table and a chart erm. But er, no I don't think, I think we used the right amount of technology because I am also aware that sometimes you can have overkill with technology. And that they spend a lot of time, I mean I bought these blue light glasses because I'm spending so much time on the computer these days and because we are now becoming more technology reliant. And especially with this pandemic, we've all had to become very, very good. And people who weren't have just had to sink or swim!

AW: Yeah, yeah. Okay, have you erm, obviously for you, you're very, very environmentally involved anyway, but do you feel that your feelings or thoughts or knowledge about the environment has changed at all through doing the programme?

P3: Well I've grown lettuce for two years on my allotment which is something I've never done before. Simply because erm, there is a lot of things that I can get plastic free, and I cannot get lettuce plastic free, and what that meant was for a number of years, we just didn't have any lettuce, erm and, sometimes you can get naked cucumbers, most of the time you can get radish and beetroot and peppers and celery, you know, to an extent some of those, but, but, but, the plastic outer on an iceberg lettuce is just ridiculous. I mean I haven't grown iceberg lettuce obviously, erm, but I've grown some other things on my allotment so on a personal level I think thinking of things that I can grow so that we can eat that seasonally.

Erm because, I don't know why, but my mum's obsessed with making things like stews and curries and stuff like that at the moment, but in December we'll be eating a chicken caesar salad, and I'm like 'why are we eating salad in the middle of December, this doesn't make any sense!' Like, why aren't we eating with the seasons? So just having to think about you know, what you can do, and obviously, the aquaponics systems means that you get lettuce 365 days a year rather than when you can grow it outside which is fantastic. Erm, I suppose it's made me look at, I suppose it's made me look at the fish in more of a erm, 'well we're wasting time if we're not growing anything from you', way. Erm, and everytime I have to clean the filters out and every time I have to poo suck the gravel I'm like 'this is such good stuff! What are we doing, what are we doing?!' but it all goes on the plants in the classroom anyway, erm, or goes on the grass outside. I don't just chuck it down the drain. Erm, so I suppose that I've thought of poo in a different way, [laughter], quote that in your masters!

AW: [Laughter] And did you feel that there was any influences on your teaching style from the way that the programme was designed to deliver, obviously in your job you've got to be really hands on anyway, but is there any noticeable things for you, that you adjusted your teaching practice?

P3: I did, I did feel like because I was letting the learning support assistants go away with a group of children and lead on a whole session that erm, if I had have created the resources, I would have wanted them delivered in a very specific way. That's sounds pretty OCD, not that I'm OCD, just I want to make sure the children are getting the best, whereas I felt like the erm, resources which were available, because they were aimed at year 9 children to be able to deliver them, there wasn't that many opportunities for it to go wrong. And I think that them having that, although I was checking up, I wasn't taking over. So saying like, 'right you've got half an hour, go away and design a logo using these things, erm, was really nice. And just giving people the opportunity to go away and let their creative juices flow. Because when I've said go away and design a logo, you know, I didn't say go away and design the logo that's in my head that would be a really good idea, because otherwise I'm curtailing people's artistic streaks and what they might like to create, so.

I think that the breaking up into teams was really good and I think that the children deciding what teams they wanted to be in. Because I think usually I deploy staff how I see fit, and I tell the children where they're going to go and who's going to work with whom. And I think that the fact that they had their own little teams was really nice and I think that actually, the children chose which thing they would be really good at, and there were groups of children that never, ever would have chosen to spend any time together, and I'm not saying that they've created long lasting friendships, but they would have never chosen to sit together or do an activity together. And when I said 'right, you've got some choose time, everybody get a game, that wouldn't have been the person that they would have chosen to play a game with. So that was quite nice.

AW: So when they were pairing up, was that because of their understanding of 'we have these skills, I know they're good at drawing so we'll work on that' or?

P3: Yeah, yeah, yeah. So when we were working at like, [member of class 1] decided that he wanted to be one of the design, er one of the building people, because he likes, he likes DIY, erm, and [member of class 2] said he liked to do that because he loves cooking, and building, taking things apart and stuff like that and [member of class 3] is very good at directing, so he decided that he wanted to be a marketing person and even though he couldn't draw it, he could tell someone what to do. But then the groups that they ended up forming, weren't necessarily the friendship groups that they would usually spend time with so I thought that was quite. I suppose we all need our eyes opening occasionally don't we? And I think we all need to be pushed out of our comfort zones on occasions and I think that whether you use that opportunity to form a long lasting friendship or whether you just see it through to the end because you know you have to. I don't know whether they did that or not, but I thought it was really interesting that they'd had the opportunity to work with different kids than they would have ordinarily.

AW: Yeah, very interesting! And just basically have you got any other comments or feedback? Or is there anything that you'd like to see improve in the future?

P3: No I thought it was all absolutely fantastic. Erm, the erm, any problems that we sort of encountered were all from our perspective because I was trying to bring four wheelchair users to the University of Liverpool, or any of those issues. I think that the erm, we have in our employability strategy a box to tick that says 'children will have an experience of attending an open day or attending a university', and those eight children will be the only ones who will be able to have that ticked off by the time that they leave school, because University is just something that is just completely unattainable to our kids. Usually. Erm, and I think that, you know, even if it was just that, the fact that they'd got the chance to go to University or had the chance to walk around a university campus, I think that the students giving us those tours, of the bikes and the cars, and all of those. You know, it was just really interesting for them to listen to other people saying things, and listen to other people, you know, talk about what they're doing and what they've done there.

AW: Yeah.

P3: Engineering programmes and what have you, and I think that because they were alongside other year 9 children, in a sort of counterpart, was really good, because they are cognitively younger than everyone else in the room, but obviously physically they're the same size, age and everything. And there was a couple of kids from some of the other schools who were just so nice, and you know, you don't have that many opportunities to rub shoulders with mainstream peers, erm, within the school setting, because if anybody ever does come to school, it's within a caring capacity. So we have some children who come to school who are doing their Duke of Edinburgh and they're coming to help us. We have some kids who are coming to complete their, erm, A Levels and GCSEs in design technology, and they are creating a piece of equipment, so they're here to help us, and we never have anyone there who's there to just be a peer.

AW: Yeah.

P3: And there was I can't remember which school it was but I can remember which member of staff it was, and I emailed them the day after and said you know, your children were a real credit to you they were really, really polite, they moved chairs out of the way so my kids could go and walk around, and I watched them interacting with them and it was all really, really nice. And those opportunities you know, they're not quantifiable experiences, they're just nice.

AW: Yeah, yeah. No, I hadn't thought about the opportunity to associate with peers in that way, so that's an interesting one to take away and think about. Well yeah, that's great! That was all the questions that I wanted to cover really, so thank you so much, as always, for all of your feedback, it's completely golden. Lots of ideas and just really good to hear that you had a good experience of it as well.

Appendix 5 – Coding book

Q1 What did you take away as the most important message from the talk today?

Code (Q1)	Definition	Examples	Considerations
Individual specific action for health	Participant identifies a specific action that could be taken regarding their personal health.	“I could exercise more” “I could eat healthier food”	
Immediate collective action for health	Participant identifies a health action that could be taken within a sphere that they actively participate in.	“My school could teach about nutrition” “My family could buy more vegetables so that we can eat healthily”	
Individual reflection for health	Participant considers how they feel in relation to the topic of health. Participant considers a piece of information that they have learnt concerning health to which they attach no action. Participant identifies an action that could be taken by an entity, which they do not vocally participate in. (distant collective)	“I like exercising” “I hate eating vegetables” “Obesity is widespread in the UK” “The government should provide more funding for healthy food in schools”	The distant collective includes entities for which, whilst participants may have differing levels of involvement, they could feasibly be a passive consumer. If a participant identifies an active relationship, for example, they are a youth councillor, their council would be considered as their immediate collective rather than distant collective.
Individual specific action for the environment	Participant considers what they could personally do that would benefit the environment	“I could recycle” “I could ride my bike”	Can be inferred from context why this would benefit the environment. E.g. riding a bike would reduce pollution from transport.
Immediate collective action for the environment	Participant identifies an environmental action that could be taken within a sphere that they actively participate in.	“My school could provide more recycling bins” “My friends and I could litter pick”	
Individual reflection	Participant considers	“I love animals and	Reference to plastic

about the environment	<p>how they feel in relation to the environment</p> <p>Participant identifies an action that could be taken by an entity which they do not actively participate in.</p> <p>Participant states information relating to environmental issues</p>	<p>don't want them to be hurt"</p> <p>"I am scared about climate change"</p> <p>"The UN could offer more guidance"</p> <p>"Single use plastic is causing harm to animals"</p>	<p>could be related to food production and consumption, due to the use of plastic in food packaging. However for consistency, as plastic use can have forms not relating to food in an environmental context, all reference to plastic will be coded at an 'environment' node rather than a 'food' node, unless the relationship to food consumption is specified.</p>
Individual specific action for sustainable food production and consumption	Participant identifies an action that they could personally take to promote sustainable food choices.	<p>"I will grow my own food"</p> <p>"I will learn more about how my food is produced"</p>	Food consumption and production has its own code outside of environmental considerations as sustainable agriculture is a specific theme of the TEDx talk specified outside of other environmental concerns.
Immediate collective action for sustainable food production	Participant identifies an action that could be taken within a sphere that they actively participate in to promote sustainable food production.	<p>"My family could buy food locally"</p> <p>"My school could grow food on site"</p>	An assumption is made from the context of the statement that buying food locally is considered to be sustainable because of the reduced food miles. This could also be an environmental action, but for consistency, direct reference to food production and consumption will be coded to 'food' rather than 'environment'.
Individual reflection about the sustainable food production	Participant considers how they feel in relation to sustainable food production	"Farmers should not use pesticide"	Whilst a statement about deception within the food industry may be true, and therefore could be coded as knowledge, the choice

	<p>Participant identifies an action that could be taken by an entity which they do not actively participate in.</p> <p>Participant states information relating sustainable food production.</p>	<p>“Fish are being taken out of the water faster than they are reproducing”</p> <p>“The food industry is lying to us”</p>	<p>of language such as ‘lying’ is indicative of an emotional reaction, and therefore will be coded as a reflection.</p> <p>Distant collective action may not be feasible, realistic, or suggested by the TEDx talk, but is a suggestion from the participant concerning what might be possible to make food production more sustainable.</p>
Individual reflection about personal future	<p>Participant considers their future, for example their education or career.</p> <p>Participant identifies a current reality external to an action that they may choose to take regarding their personal education or career options.</p> <p>Participant considers how they feel in relation to their education or career options.</p>	<p>“I will study science”</p> <p>“I will do a job that I like”</p> <p>“Going to university opens up options”</p> <p>“It is possible to start your own business”</p> <p>“It is important to know why you want to do a job”</p>	<p>These statements could be coded as actions relating to the environment, as studying science could be motivated by the aim to solve environmental problems. However, for consistency, statements relating to education or career will be coded at the personal future node, under a child node of whether it is specified whether this is for an additional environmental end.</p>
Individual reflection about Farm Urban	<p>Participant considers how they feel about Farm Urban’s activities</p> <p>Participant considers the purpose and practices of Farm Urban as an organisation.</p> <p>Participant reflects on what became evident to them by being present at the talk.</p>	<p>“They care about people”</p> <p>“Farm Urban is Liverpool’s first hydroponic farm”</p> <p>“The talk is really inspiring”</p>	
Individual reflection about Farm Urban’s	<p>Participant reflects on what became</p>	<p>“The talk is really inspiring”</p>	<p>Whilst reflections about Farm Urban</p>

TEDx Talk	evident to them by being present at the talk.	“The presenter has great hair”	could have been independent of who was delivering the talk, reflections of the talk itself have been derived from hearing the talk at that time and in a specific place.
Negative response	The participant does not consider that the premise of the statement is true.	“Nothing” “I didn’t think anything was important”	The question asked ‘What did you take away as the most important message from the talk today?’ A negative response challenges the assumption in the question that anything was taken away from the message.
Blank	Participant has chosen not to fill in an answer.	“[blank]” “X” “N/A”	
Illegible	It has not been possible to understand the writing of the participant		
Miscellaneous	It has not been possible to identify the response according to any existing code.	“I don’t like Mrs Allen”	This may be a reflection on a teacher who is in the room, and therefore has direct relation to the participants experience of the talk, however it is not possible to identify whether Mrs Allen was in the room or not when the talk was taking place.
Change in behaviour	Participant recognises that a change in behaviour must occur, but does not specify in what regard.	“We need to act differently” “Things have to change”	
Concern for human welfare	Participant considers the information in terms of its affect on society Participant considers that they should act to help other people	“I need to help my community” “If things don’t change my kids won’t be able to eat”	

Doesn't know	Participant has written that they do not know in response to the question	"dunno" "not sure"	
Emotion or attitude response	Participant demonstrates an emotion or articulates an attitude towards a topic	"You can do anything if you try" "I feel calmer about getting a job"	

Q2 In what way does this message inspire you personally when you think about your future?

Code	Description	Examples	Considerations
Individual specific action concerning health choices	Participant relates a theme from the talk to an action that they could take concerning health choices.	"I could exercise more" "I could eat more vegetables"	
Individual specific reflection concerning health choices	Participant considers themes relating to health	"Obesity is a problem in the UK"	
Individual specific action about what food to eat	Participant relates a theme from the talk to an action that they could take concerning food choices	"I could buy organic food" "I could stop eating meat"	Statements relating to food choices could also be considered as health choices. Statements will be coded as health choices unless a specific dietary choice is identified, for example organic or vegetarian food.
Individual action about food sustainability	Participant makes a food choice due to its environmental impact Participant proposes an action relating to the sustainability of the food system	"to grow my own food" "To question where my food comes from"	
Individual reflection concerning food choices	Participant displays an understanding of the practices associated with food production	"My fish comes from across the world" "I understand how aquaponics works"	
Individual reflection concerning animals	Participant considers whether an issue	"I don't like how animals are being	The emphasis for this code is on animal

	relates to animals	treated” “we should look after the cows”	welfare, however statements relating to vegetarianism or eating fish will be coded as food choices
Individual specific action concerning animals	Participant considers that they should take action regarding animal welfare	“I should do more to help animals” “I will raise awareness about animal welfare”	
Individual reflection concerning humanity	Participant considers how humans will be affected in relation to the themes of the talk	“think about the effect on future generations” “some people don’t care”	
Individual specific social action	Participant states an action that they could take to help social needs.	“I should look after people more” “I could donate money to a charity that helps people”	
Doesn’t know	Participant states that they do not have an answer	“I don’t know” “not sure”	
Eat healthily to help the environment	Participant reflects upon the link between health and environmental welfare	“we can help the Earth by eating healthily” “Eating healthily helps us and the planet”	These answers could have been coded as health or food choices but a code was created to identify where participants identified a link between healthy food choices and environmental sustainability
Individual reflection concerning education	Participant expresses a thought about their education Participant reflects on a theme in the talk related to their education	“Higher education could help me in the future” “If I don’t get good GCSEs there will still be good jobs”	
Individual specific action concerning education	Participant identifies an action that they could take relating to their education	“I would like to study biology” “I want to go to university”	
Emotion or attitude response	Participant reflects upon how the	“I think I need to work hard to achieve	

	<p>question makes them feel</p> <p>Participant reflects upon how the talk made them feel</p> <p>Participant considers an attribute they have/would like to have</p>	<p>what I want”</p> <p>“You should be passionate about what you do”</p>	
Individual action concerning the environment	Participant identifies an action that they could take which would benefit the environment	<p>“I could recycle more”</p> <p>“I need to tell people about the problems”</p>	
Individual reflection concerning the environment	<p>Participant reflects on new or existing knowledge</p> <p>Participants reflect on how they feel about the environment</p>	<p>“I didn’t know about the impact of the food industry on the environment”</p> <p>“I want the world to be healthy”</p>	
Individual reflection about Farm Urban	Participant expresses an opinion about Farm Urban	<p>“I think what they’re doing is a good idea”</p> <p>“I’m not interested in what they do”</p>	Comments about Farm Urban could be negative. They will be coded as negative responses unless the surrounding content demonstrates that they found the talk interesting or useful for example, but would not like to work at Farm Urban.
Individual reflection about Farm Urban’s talk	Participant reflects on the talk itself rather than a theme discussed	<p>“The man at the front seemed very clever”</p> <p>“I liked the graphics on the screen”</p>	
Negative response	The participant does not consider that the premise of the statement is true.	<p>“I do not feel inspired”</p> <p>“No”</p>	
Blank	Participant has chosen not to fill in an answer.	<p>“[blank]”</p> <p>“X”</p> <p>“N/A”</p>	
Illegible	It has not been possible to understand the		

	writing of the participant		
Miscellaneous	It has not been possible to identify the response according to any existing code.	"I'm tired today"	
Individual reflection concerning personal future	Participant articulates their thoughts about their own future Participant identifies links between the talk and their own future	"I want to do a job that I care about" "Maybe I could work in a job that's also good for the environment"	
Individual specific action concerning personal future	Participant identifies an action that they could take relating to their future.	"I want to start thinking about possible careers now" "I should do more extra curricular activities now because they will be helpful for my future"	
Unspecified positive response	Participant expresses that they enjoyed the talk but provides no further details	"Great" "It did"	

Q3: How has today helped you to think about your future goals and the steps you plan to take to achieve them?

Code	Description	Examples	Considerations
Individual specific action concerning health choices	Participant relates a theme from the talk to an action that they could take concerning health choices.	"I could exercise more" "I could eat more vegetables"	
Individual specific reflection concerning health choices	Participant considers themes relating to health	"Obesity is a problem in the UK"	
Individual specific action about what food to eat	Participant relates a theme from the talk to an action that they could take concerning food choices	"I could buy organic food" "I could stop eating meat"	Statements relating to food choices could also be considered as health choices. Statements will be coded as health choices unless a specific dietary choice is identified, for example organic

			or vegetarian food.
Individual action about food sustainability	Participant makes a food choice due to its environmental impact Participant proposes an action relating to the sustainability of the food system	“to grow my own food” “To question where my food comes from”	
Individual reflection concerning food choices	Participant displays an understanding of the practices associated with food production	“My fish comes from across the world” “I understand how aquaponics works”	
Individual reflection concerning animals	Participant considers whether an issue relates to animals	“I don’t like how animals are being treated” “we should look after the cows”	The emphasis for this code is on animal welfare, however statements relating to vegetarianism or eating fish will be coded as food choices
Individual reflection concerning humanity	Participant considers how humans will be affected in relation to the themes of the talk	“think about the effect on future generations” “some people don’t care”	
Individual specific social action	Participant states an action that they could take to help social needs.	“I should look after people more” “I could donate money to a charity that helps people”	
Doesn’t know	Participant states that they do not have an answer	“I don’t know” “not sure”	
Eat healthily to help the environment	Participant reflects upon the link between health and environmental welfare	“we can help the Earth by eating healthily” “Eating healthily helps us and the planet”	These answers could have been coded as health or food choices but a code was created to identify where participants identified a link between healthy food choices and environmental sustainability
Individual reflection concerning education	Participant expresses a thought about their	“Higher education could help me in the	

	education Participant reflects on a theme in the talk related to their education	future” “If I don’t get good GCSEs there will still be good jobs”	
Individual specific action concerning education	Participant identifies an action that they could take relating to their education	“I would like to study biology” “I want to go to university”	
Emotion or attitude response	Participant reflects upon how the question makes them feel Participant reflects upon how the talk made them feel Participant considers an attribute they have/would like to have	“I think I need to work hard to achieve what I want” “You should be passionate about what you do”	
Individual action concerning the environment	Participant identifies an action that they could take which would benefit the environment	“I could recycle more” “I need to tell people about the problems”	
Individual reflection concerning the environment	Participant reflects on new or existing knowledge Participants reflect on how they feel about the environment	“I didn’t know about the impact of the food industry on the environment” “I want the world to be healthy”	
Individual reflection about Farm Urban	Participant expresses an opinion about Farm Urban	“I think what they’re doing is a good idea” “I’m not interested in what they do”	Comments about Farm Urban could be negative. They will be coded as negative responses unless the surrounding content demonstrates that they found the talk interesting or useful for example, but would not like to work at Farm Urban.
Negative response	The participant does not consider that the	“I do not feel inspired”	

	premise of the statement is true.	“No”	
Blank	Participant has chosen not to fill in an answer.	“[blank]” “X” “N/A”	
Illegible	It has not been possible to understand the writing of the participant		
Miscellaneous	It has not been possible to identify the response according to any existing code.	“I’m tired today”	
Individual reflection concerning personal future	Participant articulates their thoughts about their own future Participant identifies links between the talk and their own future	“I want to do a job that I care about” “Maybe I could work in a job that’s also good for the environment”	
Individual specific action concerning personal future	Participant identifies an action that they could take relating to their future.	“I want to start thinking about possible careers now” “I should do more extra curricular activities now because they will be helpful for my future”	
Had already planned goals	Participant described existing goals that had been planned before the talk	“I already plan to become an accountant”	
Unspecified positive response	Participant expresses that they enjoyed the talk but provides no further details	“Great” “It did”	

Appendix 6

“Developing a low carbon future through Industry 4.0 Ed-tech tools” Research

Teacher information sheet, version 4, 10th April 2020

You are being invited to take part in a research study concerning the development of low carbon technology education. As you have facilitated the Future Food Challenge in partnership with Farm Urban, we would like to ask you a series of questions about delivering the programme and your thoughts about how the programme can develop further. Before you decide whether you would like them to participate, it is important for you to understand why the research is being done and what it will involve. We would like to stress that you do not have to accept this invitation and should only agree to take part if you want to.

Thank you for reading this.

1. What is the purpose of the study?

The Future Food Challenge is an educational programme concerning the sustainability of food production. Students are invited to learn how their food is produced, learn about urban farming, and build their own aquaponics system (a way of growing fish and plants together). Farm Urban are developing an online resource to give students more help and guidance as they complete the project, and would like your opinions on what you feel could be improved about the programme. This research study is to learn what both students and teachers think about the environment, food production and education, to better understand how that impacts their participation in the project.

2. Why have I been asked to take part?

Your class has taken part in the Future Food Challenge, along with other schools across Merseyside. The research will try and gather the views of as many participants in the project as possible.

3. Do I have to take part?

If you do not wish to participate in the research then you can choose not to.

4. What will happen if I take part?

- The research will be conducted by Abby Williams, an MPhil student at the University of Liverpool. She will complete an interview with you, for which you will be sent the questions in advance.
- You will be asked to complete an exercise to rank different statements about the programme in order of how important you feel they are.
- You will be asked to fill in a survey.

5. How will my data be used?

The University processes personal data as part of its research and teaching activities in accordance with the lawful basis of 'public task', and in accordance with the University's purpose of "advancing education, learning and research for the public benefit.

Under UK data protection legislation, the University acts as the Data Controller for personal data collected as part of the University's research. The Student Investigator Abby Williams acts as the Data Processor for this study, and any queries relating to the handling of your personal data can be sent to Abigail.Williams@liverpool.ac.uk.

Further information on how your data will be used can be found in the table below.

How will your data be collected?	Through interviews, where written notes will be taken.
How will my data be stored?	Your data will be anonymised and stored securely and electronically on University computer servers.
How long will my data be stored for?	The data will only be used for this specific project, and will be stored for a minimum of five years before being deleted.
What measures are in place to protect the security and confidentiality of my data?	The student investigator will carry out all aspects of the research, so no data will be shared until it is anonymised.
How will my data be used?	The data will be evaluated, and based on the themes that emerge from all participant responses, Farm Urban may choose to adjust their programme content to better meet the needs of students undertaking the programme.
Who will have access to my data?	Anonymised data will be provided in an evaluation report to Farm Urban, and in the Student Investigators' MPhil Thesis.
Will my data be archived for use in other research projects in the future?	Yes

How will my data be destroyed?	Data collected for the project will be deleted from the University server after a minimum of five years.
--------------------------------	--

6. Are there any risks in taking part?

There are no perceived disadvantages to taking part in this study, however, if you should not wish to answer any questions during the study, you are welcome to decline to answer.

7. Are there any benefits in taking part?

Your feedback will help to develop a project for use by other students, and help to alleviate challenges that frustrated the delivery of the programme.

8. What will happen to the results of the study?

The results of the study will be made available to Farm Urban in an evaluation report, as well as being present in the thesis of the Student Investigators' MPhil. Should you wish to receive a copy of the research, you are welcome to provide contact details.

9. What will happen if I want to stop taking part?

You can withdraw from participation in the study at any time, without explanation.

Results up to the period of withdrawal may be used, if participants are happy for this to be done. Otherwise you may request that the results are destroyed and no further use is made of them. Once anonymised, it will not be possible for results to be destroyed. If you would like to withdraw from the research, you may speak to the Student Investigator Abby Williams.

10. What if I am unhappy or if there is a problem?

If you are unhappy, or if there is a problem, please feel free to let us know by contacting Abigail.Williams@liverpool.ac.uk and she will try to help. If you remain unhappy or have a complaint which you feel you cannot come to her or the Principal Investigator, Adam Mannis (email: A.Mannis@liverpool.ac.uk) with then you should contact the Research Ethics and Integrity Office at ethics@liv.ac.uk. When contacting the Research Ethics and Integrity Office,

please provide details of the name or description of the study (so that it can be identified), the researcher(s) involved, and the details of the complaint you wish to make.

The University strives to maintain the highest standards of rigour in the processing of your data. However, if you have any concerns about the way in which the University processes your personal data, it is important that you are aware of your right to lodge a complaint with the Information Commissioner's Office by calling 0303 123 1113.”

11. Who can I contact if I have further questions?

Please contact the Student Investigator Abby Williams by email on Abigail.Williams@liverpool.ac.uk with any further questions.

Disclosure Barring Service check (DBS)

The researcher involved in this project has obtained a DBS check and you may request evidence of the DBS from the Principal Investigator.

Appendix 7

Teacher consent form

Version 4, 10th April 2020

Research ethics approval number:

Title of the research project: Developing a low carbon future through Industry 4.0 Ed-tech tools

Name of researcher(s): Adam Mannis, Abby Williams

Please initial
box

- | | |
|--|--------------------------|
| 1. I confirm that I have read and have understood the information sheet dated for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. | <input type="checkbox"/> |
| 2. I understand that taking part in the study involves being asked questions about my facilitation of the project. | <input type="checkbox"/> |
| 3. I understand that my participation is voluntary and that I am free to stop taking part and can withdraw from the study at any time without giving any reason and without my rights being affected. In addition, I understand that I am free to decline to answer any particular question or questions. | <input type="checkbox"/> |
| 4. I understand that I can ask for access to the information that I provide and that I can request the destruction of that information if I wish at any time prior to anonymisation. I understand that following anonymisation I will no longer be able to request access to or withdrawal of the information I provide. | <input type="checkbox"/> |
| 5. I understand that the information I provide will be held securely and in line with data protection requirements at the University of Liverpool until it is fully anonymised and then archived for sharing and use by other authorised researchers to support other research in the future. | <input type="checkbox"/> |
| 6. I understand that signed consent forms will be scanned and shredded. Scans will be retained until the study is complete. | <input type="checkbox"/> |
| 7. I agree to take part in the above study. | <input type="checkbox"/> |

Teacher's name

Date

Signature

Student Investigator, Abigail Williams, School of Engineering, L69 3BX Brownlow Hill,
Liverpool L69 3GH, Abigail.Williams@liverpool.ac.uk

Principal Investigator, Adam Mannis, School of Engineering, L69 3BX Brownlow Hill,
Liverpool L69 3GH, A.Mannis@liverpool.ac.uk

Appendix 8

Interview questions - Teachers

Participation in the project

1. What motivated you to take part in the Future Food Challenge?
2. What do you think is the most important aspect of this project?
3. What did you hope to achieve by taking part?
4. How much do you feel your school facilitates environmental sustainability education and activity?

Experience of the project

1. What was your favourite part of facilitating the challenge?
2. What did you least enjoy?
3. What did you find the most difficult?
4. Did you feel that the preparation that was required of you to deliver the programme was manageable?

Learning style

1. What skills did you feel that students developed?
2. What activities helped them to learn the most effectively?
3. What activities did not help them to learn as effectively?
4. How much do you currently use technology such as computer programmes in your lessons?
5. Did you find the Future Food Challenge website (with slides and extra resources) helpful? Why/why not?
6. Do you feel that the programme has contributed to your continuing professional development? If so, how?
7. What aspects of the online platform would you like to be developed further?
8. How successfully do you feel that the programme as it stands could be delivered remotely from the Farm Urban team?

Outcomes

1. Have you got any suggestions for anything else that you would want from the programme?
2. Have your feelings about the environment changed through completing this programme?
3. Has the programme influenced any aspect of your teaching practice?
4. Did you feel that the programme achieved what you wished for it to?

Appendix 9 – Skills resources created

Listening



What is listening?

Listening is not just about what you hear - it is also:

- a) interpreting what is being said
- b) Thinking about the way it is being said
- c) How you respond to the information

Watch [this video](#) to learn more about listening in a group.

Active listening

Active listening is a way of listening which takes into account more than what you are just hearing, but also what you are hearing and understanding. The [Open University](#) outlines the following techniques to help you to listen in this way:

Pay attention to everyone's **body language**

Stay **open minded** about what the other person is saying



Repeat back what the other person has said to show you're listening and check that you understand.

Ask questions to make sure that you're clear about what they are saying

Summarise your thoughts about what they have said to you

Address any concerns about what they have said

Listen to [this TED talk](#) to learn five ways that you can listen better.



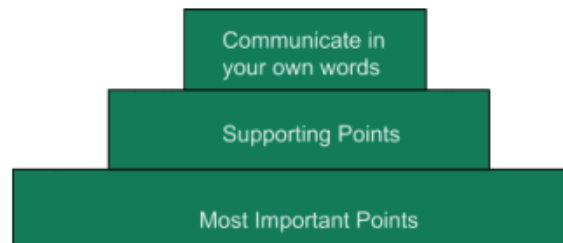
What do you remember about aquaponics from your first session?

Question	Clue	Explanation
What does a fish produce?	A diagram of an ammonium ion (NH ₄ ⁺) with a central orange circle containing "NH ₄ " and a "+" sign, surrounded by four smaller orange circles.	
What compound does a plant need to grow?	A diagram of a nitrate ion (NO ₃ ⁻) with a central orange circle containing "NO ₃ " and a "-" sign, surrounded by three smaller blue circles.	
Where does bacteria live on your Produce Pod?	A diagram of a Produce Pod showing three stacked layers. The top layer has green plants, the middle layer has small white cubes (bacteria), and the bottom layer has a grey base.	
What are the advantages of growing food in this way?	A world map showing the continents in green and the oceans in light blue.	

Summarising Information



A Quick Guide



Deciding your most important points

- a) Who are you summarising the information for?
- b) What do you want them to know?
- c) What points **have** to be said in order for your information to make sense?
- d) Are there any points that are saying the same thing? Try to avoid duplication.
- e) Think of all of the paragraphs that you are trying to summarise. Try and reduce them down to one or two sentences.

Supporting Points

- a) Explain your main points in a little more detail.
- b) Explain why your main points are important.
- c) Organise your thoughts in a logical way e.g. in a timeline, in order of importance.
- d) Provide evidence e.g. using quotes, statistics or diagrams.

Communicate in your own words

- a) Make sure that you understand what you are trying to explain.
- b) Explain the information in a way that is easy for you and your audience to understand.
- c) Write down your summary in a way that is easy for you to refer to if you are presenting the information. E.g. a mind map, bullet points, pictures.

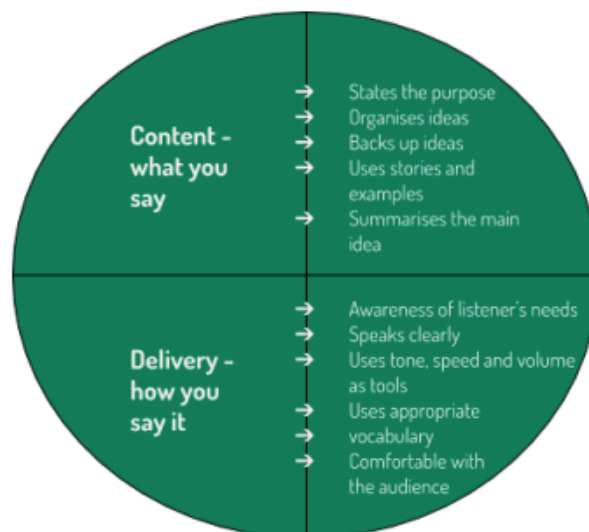


Presenting information

The ability to present information well is a skill that is sought after by employers, as well as being useful across all walks of life. Many people struggle to do this, in fact at least 25% of people say that they are scared of public speaking¹. Everything becomes easier with practice, and during the Future Food Challenge, you can use the opportunity in working with a small group to practice your presentation skills.

In any project, members of a team will work on different parts, and it is important to regularly feed back to each other to ensure that you know what is happening across the project as a whole. This prevents people from doing work that someone else has already done, means that all elements of the project work well together and enables great ideas to be shared.

For project updates, once you have summarised the important information, you can practice sharing with your group briefly and clearly. The University of York's Engineering Department summarised some points that they were looking out for in their student's presentations²:



¹ Theo Tsousides Ph.D. 'Why are we scared of public speaking', *Psychology Today*, 27/11/17

² Jackson, Noel & Ward, Tony. (2015). Assessing public speaking. 10.1109/ITHET.2014.7155700.



Practice Sheet

You will be asked to present a type of aquaponics system. Think about how the structure above can be used to present the information. You can use the following template to organise your presentation:

Main points	Answer	How I will communicate this information (e.g. talking, graph, picture)
The system is...		
Here's how the system works....		
Is it a good system to consider for our prototype?		
Supporting points		
Advantages of the system are...		
Disadvantages of the system are...		
Here is a diagram/image to show you how it works...		
We should/should not use this system because...		

Creativity



What is Creativity?



Creativity is the ability to use **your imagination to express yourself**. This includes thinking of new, innovative ideas, however it is also about developing practical solutions to everyday problems. Watch a video about the ways in which you are creative [here](#)

Tips for Developing Your Creativity

Tim Harford - Slow-motion Multitasking	Manoush Zomorodi - Focussing on one subject
<p>Harford suggests that creative people, such as Einstein, work on many long-term projects at the same time. This helps you to be creative because:</p> <ol style="list-style-type: none"> 1) Creativity often happens when you take an idea from its original context and move it somewhere else 2) Learning to do one thing well often helps you do something completely different well 3) Switching topics helps you to come back to your project with fresh eyes - e.g. when you can't remember something and you suddenly remember when you're doing a completely different task 	<p>Zomorodi discusses how technology forces us to focus on multiple things at once. She considers how tiring this can be. According to Dr Daniel Levitin, 'every time you shift your attention from one thing to another, the brain has to engage a neurochemical switch that uses up nutrients in the brain to accomplish that.'</p> <p>Zomorodi challenges people to stop distracting themselves with technology and allow your mind to wander in order to let your brain be productive and creative. As Harford says, it is good to multitask, but in slow motion - when you're working on each topic you need to allow your brain space to think deeply.</p>



Unleash your creativity

Everyone has unique ways of expressing themselves. Creativity can often take the form of something artistic, but you don't need to be artistic to be creative. This is because creativity is about creating something new, so if you have made up a game, completed a scientific experiment in a new way or solved a problem, these are all different ways of showing creativity.

Keep a record of when you have done something creative, and think about what helped you to generate the new idea/concept/product.

Was it quiet or loud?		
Where was I?		
What time of day was it?		
	Was I with people or alone?	
	What was I doing before I was creative?	
		What caused me to be creative at that moment?
		How did I feel?

Problem Solving

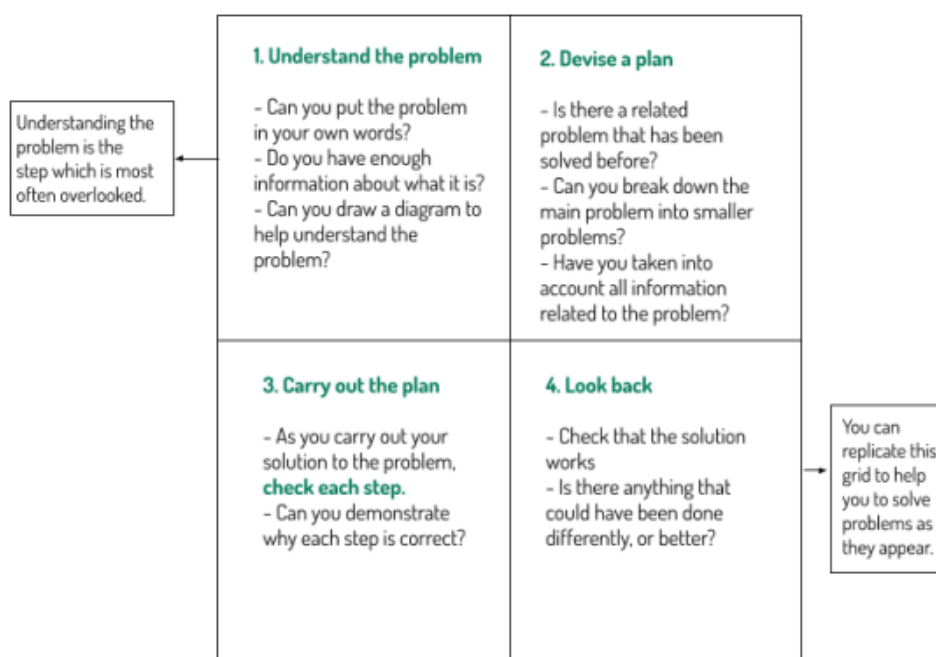


"Failure is success in progress"

Albert Einstein

As you develop your design concept, you may come across barriers that stop you from moving forwards. This is common with any start up, and whilst it can be disheartening, problem solving is key to the success of any good idea. ¹

In 1945, the mathematician George Pólya outlined four principles to problem solving²: These principles are used outside of mathematical problem solving:



Remember to look at each problem separately:



In 1942, Abraham Luchins introduced the 'water-jar problem' as a psychological study. He noticed when working with students that once they had solved a complex problem, 81% of students used the same method to solve other problems, despite there being an easier way! Look at each difficulty as a **new** problem **before** using previous solutions so that you don't overcomplicate it! ³

¹ <https://www.goodreads.com/quotes/424937-failure-is-success-in-progress>

² <https://math.berkeley.edu/~gmelvin/polya.pdf>

³ <http://www.oxfordreference.com/view/10.1093/oi/authority.2011080302257782>

Problem Solving



At Farm Urban, we decided that the big problem that we wanted to try and help to solve is unsustainable food production. If you feel that this is an issue that you feel passionate about and want to find out more, here are some sites you can visit for more information:

- 1) Farm Urban - <https://www.farmurban.co.uk/>
- 2) AMP Global Youth - <https://ampglobalyouth.org/students/top-5-problems-global-food-system/>
- 3) Biotechnology and Biological Sciences Research Council - <https://www.foodsecurity.ac.uk/challenge/>
- 4) United Nations - http://www.un.org/waterforlifedecade/food_security.shtml
- 5) BBC Bitesize - <https://www.bbc.com/bitesize/guides/zf6fr82/revision/1>

Aiming High

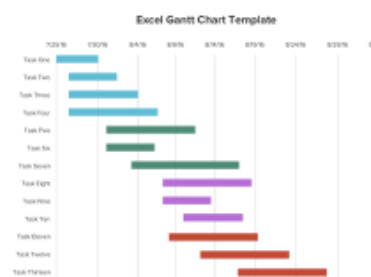


Planning and organising

Once you have established your design concept, understood what your team needs to achieve by the end of the project and what your role is within the team, it is important to have a way of tracking the team's progress as a whole to ensure that everybody is on track.

Everybody has their own preferred ways of planning and organising, however it can be helpful to share ideas, or try different methods of organisation to ensure that you are working in a style which helps you to be the most productive.

One method of project scheduling is by using a **Gantt Chart**. This is a bar chart which visualises what tasks need to be done and when during the lifetime of a project.



Example Gantt Chart

Put together a list of your team's tasks and write these down the left side of the chart.

Put the timescale along the top (hour/day/week) and draw a coloured bar for each task to see what will be done when.

There are also different programmes available on the internet which can help you to manage projects. Two such programmes include:

<https://asana.com/resources/effectively-manage-team-workload>

<https://trello.com/en>

These programmes can be used to assign tasks to group members and add due dates to tasks. This means that everyone in the team can see what is happening in other areas of the project, and if there are any anticipated problems, work together to ensure the project stays on track.

Aiming High



Managing your own workload

There is often a tight schedule to deliver projects and many different tasks to complete in a short space of time. It is important that each member of the team understands what their role is, and manages their own work to ensure that everything is completed before the project deadline.

	Understanding the task	Timeframe	
	What is your role within the overall project?	Is this achievable within the timeframe of the project?	→ Ensure that you understand what you are being asked to achieve and when.
	What are your tasks?	What order do your tasks need to be completed in?	→ Can other team members complete their tasks before you have completed yours?
	What are your subtasks? (What steps do you need to take to achieve each task)	What order do your subtasks need to be completed in?	→ If you are struggling to complete a task and are getting behind schedule, think about who you can ask for help.
	What outcomes for the project will result from your work?	What tasks would it be detrimental to the project not to complete by the deadline?	→ When there is tight deadline it is important to balance what you wish to achieve with what must be achieved for the success of the project.
	Outcome	Deadline	

Staying motivated

One of the most difficult aspects of completing any task is maintaining the momentum that we had at the beginning, right through to the end of the project. If you find yourself becoming demotivated:

- 1) **Re-visit the 'why' of the project** - remembering what your motivations are, and the outcomes that you wanted at the beginning can help to refocus your mind on the important points, and think of new solutions to problems that have arisen.
- 2) **Don't isolate yourself** - If you have doubts or concerns about what you are doing, you can often find yourself procrastinating! Make sure that you talk to other project members or your teacher to address your concerns, as this will reduce anxiety when you realise that you are not alone in your concerns! Together, you can work to find solutions.

Staying Positive



During the Future Food Challenge, you have achieved many different things! Over the last two months you have:

- **Learnt about future food problems and solutions**
- **Learnt how to build an aquaponics system**
- **Worked within a team**

You have also spent some time thinking about your place within the team, what skills you have and how your skills directly relate to solving future food problems.

During any project, you will encounter difficulties. There will be elements that you find more challenging than others, and you may face problems that are out of your control. One of the most difficult skills to develop is **taking responsibility** for the things that you can control. When something goes wrong, it is easier to say that it is not your fault, than to recognise that you are part of a team, and may need to 'go the extra mile' to ensure that the project is successful. This means putting aside blame and complaints, and focusing on what is within your power to change to make the project a success.

This relates directly to knowing who you are, what is important to you, and how this equips you to solve problems. The physicist Alan Lightman highlights why this is even more challenging for people today - "By not giving ourselves the minutes — or hours — free of devices and distractions, we risk losing our ability to know who we are and what's important to us". Lightman suggests that an important way of taking responsibility is to recognise that we need to allow ourselves moments of quiet to let our minds be creative, explore new ideas and have space to work out what is important to us.

Think of some ways that you can give your mind some space and calm, and how you can make doing this a habit.

Leadership

Each week you are a member of the team. You may have been thinking about your place **within** the team, what your own skills offer **for** the team, and how what you are passionate about is **relevant** to the team. Throughout the challenge, you will have the opportunity to be a team leader, and it is important to think about what this means and how you can do so effectively.

The author and organisational consultant Simon Sinek says that the best leaders are those that communicate from the inside out. That is, they don't communicate what they are doing or how they are doing it, but **why** they are doing it. He calls this the golden circle.

The Golden Circle

WHAT

Every organization on the planet knows WHAT they do. These are products they sell or the services

HOW

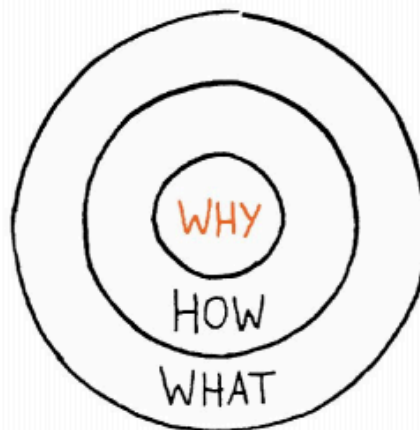
Some organizations know HOW they do it. These are the things that make them special or set them apart from their competition.

WHY

Very few organizations know WHY they do what they do. WHY is not about making money. That's a result. WHY is a purpose, cause or belief. It's the very reason your organization exists.



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[Link to talk here](#)

Sinek outlines that the best way of leading is to communicate to people what you believe and why. When people believe the same thing, they will join you wholeheartedly in trying to work out how to achieve your goals because they want to, not because they think that they have to. This is important within your own group when it is your turn to be team leader, but also with any project when you're thinking about how to communicate with your audience.

Use the golden circle structure to write down your own understanding of the 'why, how and what' for your team's project, or for other relevant projects that you are working on.



Teamwork

Giving constructive feedback

When you are working in different roles on a project, it is important that everyone communicates together effectively. The Future Food Challenge sessions allow time for each group to give **constructive feedback** to other members of the team, however giving your thoughts on someone's ideas and identifying ways that their work can be improved is a great skill that is challenging and requires practice. [Cabrillo College](#) highlights that "constructive feedback is a tool that is used to build things up, not break things down. It lets the other person know that you are on their side".

Case study

In a [neurological science experiment](#), scientists separated a group of students into two groups. One group was asked about their dreams and how to go about achieving them, and the other group was asked about what they were doing wrong and needed to fix. They hooked students from each group up to an fMRI machine to measure their brain activity. The study showed that those in the "dreams" group the parasympathetic nervous system lit up - the part which stimulates a growth of new neurons, produces a sense of wellbeing and of openness. In the "fixing" group, their 'fight or flight' response was stimulated, diverting away from parts of the brain for creativity and focusing only on the basics to survive. By focusing on the positives of someone's work, we can help their brains to think of new solutions to problems and develop good work further.

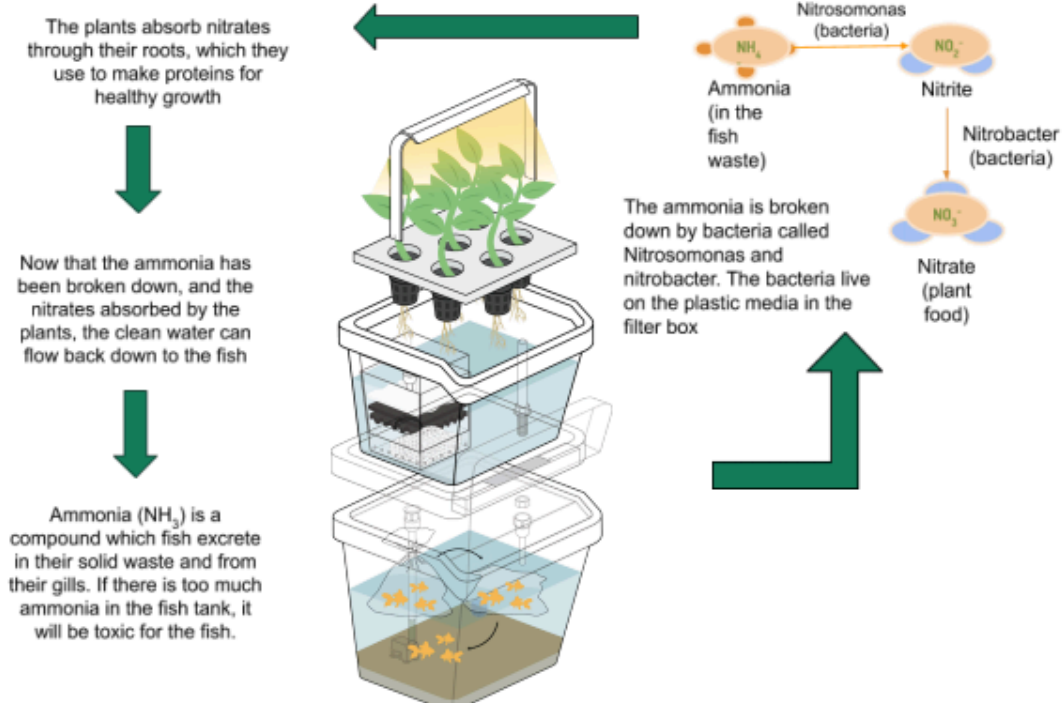
Nottingham University outlined [points](#) to consider when giving feedback:



Appendix 10 – Session summary resources created



The Science of Aquaponics



Why is a system like this good for the environment?

- You can take food as you need it - this reduces waste
- The food does not need to be packaged if this system is in your home
- The water is being recycled
- There is a low carbon footprint as the food has not needed to be transported.

During today's session, your **Listening** skills were required.

You had to:

- Listen to your team leader explain the science behind how the aquaponics system works
- Take part in discussions about how to build the system
- Ask questions if there was anything you didn't understand



This is a really important skill for many different areas of your life.



Think!

To build a system like this, different skills and knowledge were needed. Engineering to design and build the system, science to understand how the ecosystem can function, knowledge, veterinary science to ensure that the fish are cared for properly, botany to ensure that the plants are healthy. Many more skills are needed to raise awareness in local communities about where food comes from, and why current food production is unsustainable. Can you think of what skills would be needed to promote a home aquaponics system? What skills do you have that you could use?

To find out more about developing your Listening skills, go to your [Skills Resources](#).

The Tech Behind Aquaponics

There are **three** main types of aquaponic system:



Flood & Drain

Water is pumped to the grow bed for 15 minutes, providing nutrient rich water to the roots of the plants. The water then drains back to the fish tank, allowing the roots to be oxygenated. The grow bed is filled with a soil substitute called expanded clay. The bacteria colonize the clay pellets, forming the biofilter.



Deep Water Culture (DWC)

Plants grow in a floating raft, with their roots suspended in water below. Water is circulated between the fish tank and grow bed. An external biofilter is needed to process the ammonia. An air pump is also required to provide additional oxygen to the water as the dissolved oxygen within the system will decrease over time.



Nutrient Film Technique (NFT)

The plants are placed in plastic guttering with their roots lying along the bottom of the gutter. A thin film of water trickles along the base of the guttering, providing nutrients directly to the tips of the roots. The remainder of the root is exposed to the air, allowing oxygen to get to the roots. A **biofilm** forms in the base of the guttering which also breaks down ammonia. However, NFT systems need an external biofilter to help break down the ammonia.

	Advantages	Disadvantages
F & D	You can grow heavy fruiting plants as well as leafy greens because there is more root support from the clay media.	The media bed gets clogged easily, enabling bacteria to grow and compete with the plants for oxygen. The system can take a long time to clean to prevent this.
DWC	The large amount of water makes this a stable system. Ammonia will be diluted in the water so can take a long time to become toxic.	These systems are really heavy because of the large volume of water.
NFT	They are light systems, and the roots are well oxygenated due to the large surface area to volume ratio.	As there is less water circulating, if anything malfunctions, the whole system will experience problems very quickly.

During today's session, you used your **Presenting** skills.

You had to:

- Research and understand an aquaponics system
- Present your system to the rest of the group, in a concise and interesting way
- Make your presentation suitable for the audience

Presenting can make you very nervous, but becomes much easier the more that you practice.

To find out more about developing your **Presenting Skills**, go to your [Skills Resources](#)



Think!

You may need to revisit this session after session 3 and 4 to check that you are able to build the appropriate system for your design.



The Business of Aquaponics

What is a Start Up Business?

- Usually run by a small group of founders
- A young company developing an innovative product or service
- Through trial and error, a business that proves what doesn't work as well as what does
- A business that wants to solve a problem where the solution is not obvious and success is not guaranteed

The most important thing for any Start Up is knowing **why** you want to do what you are trying to do.



Think!

Choosing Your Role

At the beginning of the role, you completed the 'Start With Why' session - during which you completed the 16 personalities test, and learnt about the following team roles:

Managing Director
Creative Director
Design Engineer

Next week you will be working in your new role, so have to submit your role preference today.

If you are unsure about which role to specialise in, think back to your personality quiz, the Start With Why session, and the work that you have completed so far throughout the programme.

Does your skill set seem to match up with a particular role?
Is there a role that you don't feel very confident in but you would like to get better at?
Do you think there is a different role that you could offer for the benefit of the team?

During today's session, you used your **Creativity** skills.

You had to:

- Brainstorm ideas to get aquaponics into your town or city
- Combine all of the ideas presented and create the best solution from all of the ideas.

Being creative does not just being artistic - there are many different ways that you can use your imagination and create something out of nothing!

To find out more about developing this skill, go to your [Skills Resources](#)



Design Your Concept

The Double Diamond design process:



Think!

Last session you thought about why you do the things you do - what you are passionate about.

This week, think about why urban farming could be an important issue. What do you think is the most important consideration:

- To reduce our carbon footprint by lowering food miles?
- To grow food in less space to support a growing population?
- To encourage people to be more involved with growing their food so that they might make healthier eating choices?

Talk with your teammates about what you think is the most important issue to ensure that you are passionate about your design concept.

During today's session, you used your **Problem Solving** skills.



You had to:

- Learn the difference between simple and complex problems
- Create a design concept concerning how to get aquaponics into your town or city

Problem Solving requires patience. It is okay to get the answer to a problem wrong, because finding out what doesn't work is important, as well as finding out what does.

To find out more about developing this skill, go to your [Skills Resources](#)

Irrigation Systems and Starting Up Your Business

How to Irrigate an Aquaponics System:


Irrigation means the supply of water to enable crops to grow. There are **three key components** to irrigating any aquaponics system:

- A fish tank
- A biofilter (containing bacteria)
- A grow bed (containing plants)

How to irrigate a Nutrient Film Technique (NFT) System


Step 1

13 mm pipe




Push fitting into 19 mm and attach to 13 mm pipe

Fitting




Cut 19 mm pipe with scissors to a short length to connect to the pump.

19 mm pipe



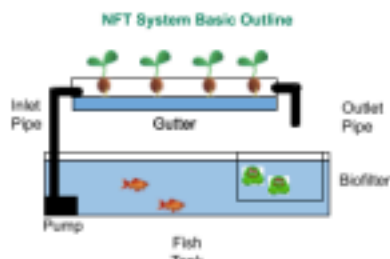
Cut 19 mm pipe with scissors to a short length to connect to the pump.

Pump




Cut your 13 mm pipe to the lengths you need, and use the different fitting types to make whatever shape of irrigation system you need for your system.

NFT System Basic Outline




Step 2

Fittings




Different lengths of 13 mm pipe.




Cut your 13 mm pipe to the lengths you need, and use the different fitting types to make whatever shape of irrigation system you need for your system.


Step 3



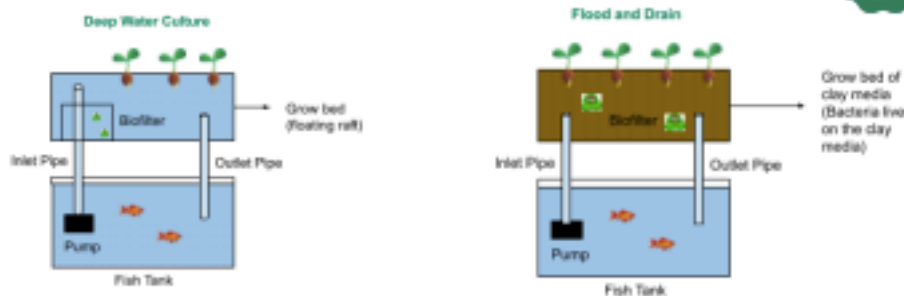
Push to pierce hole

+





Where you need your 13mm pipe to join your NFT gutter, use a 4mm joining pin to pierce a hole into the 13mm pipe - Just push it directly into the pipe. Then, attach the length required of 4mm pipe to the other end of the joining pin. Put the other end of the 4mm pipe into the 4mm hole at the end of the NFT gutter.



Deep Water Culture and Flood and Drain systems have the same irrigation structure as your Produce Pod. Have a look at the Produce Pod in your classroom to remind yourself of how its irrigation system works.

See [this video](#) if you need more help assembling your irrigation system.

Writing your Vision, Mission and Values

Your **vision** is the **long-term change you want to create**. It's a shared image of where you want your business to go. A vision statement is a single sentence.

Your **mission** explains why your company exists: **what you aim to do and how you plan to do it**. A mission statement is a single sentence.

Your **values** describes **what your company believes in and how it will behave**. It defines the morals and principles that guide your decision making. A values statement is 5 or 6 words or short phrases.



Think!

What long-term changes do **you** want to see as a result of your company's activities? Think about your city and the problems that you think are the most important to solve. How could your business help? This could be by providing healthy food to those who need it, providing job opportunities for people who need work or putting your aquaponic system into a place where people may find the plants and trickling water relaxing to help them de-stress!

During today's session, you used your **Teamwork** skills.

You had to:

- Adjust to working in your new role and smaller team
- Decide as a team what your vision, mission and values are
- Think about how you can contribute your unique skills to your team.



To find out more about developing this skill, go to your [Skills Resources](#)

Teamwork itself requires many different skills. You need to learn the strengths of your team mates and what they struggle with, as well as understanding this about yourself. This is so that when you or a team mate is struggling to do a task that does not come naturally, the team can work together to support everyone to develop their skills.



Technical Drawings and Market Research

Making a Technical Drawing

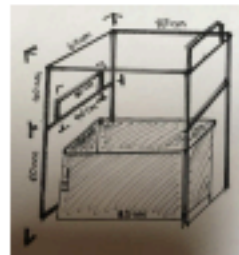
A technical drawing enables you to:

- Check that your concept drawing works functionally
- Work out what materials you need
- Work out the size of the materials you need

Example Frame Drawing

Parts list

530cm metal bar
4 three way elbows (corner)
8 two way elbows
8 three way elbows (T)



Creating a Customer Profile

A customer profile is a description of your **ideal customer**. By trying to get inside their head and **imagine what their life looks like** you can start to think about how to market your product to them. If you are interested in psychology, this is a really fascinating activity as you are looking at **why humans act the way that they do**.

The Facts			Behaviour	
What's their name?	Where do they live?		Daily routine	Things they do for fun
Income?	Job?	Family?	Hobbies	Other habits
Values			Needs and Goals	
Personality		Moral beliefs	Goals for this year	Life ambitions
People they admire			Typical/daily problems	How can you help?
What's important to them in life?				



Market Research

Market research is the process of gathering information about your potential customers (the market). The better you know your customers the easier it is to sell them your vision - and your product.

Market research is about finding out what your customer needs and likes. This helps to ensure that your product is right for them, and that you present it to them in the right way.

When you are planning your market research, it is important to use your customer profile and think about how you are going to get in touch with your customers:

- Are they likely to use social media?
- Would they respond to posters in public places?
- Is there a community space that they regularly visit that you could advertise in?



Think!

Giving constructive feedback

Today the team will be listening to the Design Engineers as they explain what they have developed so far and what they are planning to do next. It can be hard to present your work in front of people, so when you are giving feedback, remember these points:



During today's session, you used your **Leadership** skills.

You had to:

- Explain your team mates' strengths and weaknesses
- Use your understanding of your team mates' strengths to help them achieve their goals



To find out more about developing this skill, go to your [Skills Resources](#)

To be a good leader, it is important that you understand more about yourself before you lead others - make sure that you spend some time reflecting on your own strengths and weaknesses, how this helps you to work with others or what you may find challenging, and how to adapt to working with others with different working styles.

Irrigation Systems and Starting Up Your Business



Iteration

When you are designing a product, or creating anything at all, you will have several **iterations** of it. To iterate means to repeat something with new information to improve it.

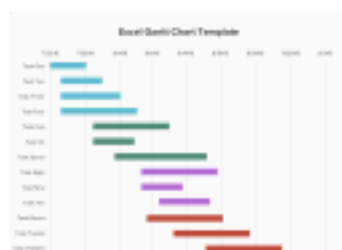


Building a **prototype** (a first version of a device) helps you to **test out** and **evaluate** your ideas, and keep making changes until you get it right.

When you are building an **iterative product** - a product which has gone through many different versions, it is important to remember that **getting things wrong is okay**. This is all part of your learning, and will result in a better product in the end.

Time Management

When completing a project like the Future Food Challenge, which has many different tasks to complete by different teams, it is important to have a **project schedule**. This is a plan showing what needs to be completed and when to meet a deadline.



This is a **Gantt Chart** which has dates along the top, and tasks along the side. This is a project scheduling tool that is used by many different businesses. When looking at your Gantt Chart, you can keep an eye on whether everything is on track, and if a deadline has been missed, work out when that work will be completed and how it will affect the other tasks.

You can also use project management tools such as [Asana](#), [Trello](#) or [Meistertask](#) where you can make a list of tasks, assign them to yourself and your teammates and set deadlines.

When you are working in a team, it is important to communicate with other team members, and make sure that you know where everyone is up to. This will help you to have a back up plan if a task hasn't been completed that affects your own tasks. If one team is behind, you can also see who is available to pitch in and help.



Designing a market research questionnaire



You need to decide what questions you are going to ask in your questionnaire to find out what you need to develop your product. You need to decide how you will ask the questions:

- Questions with a YES/NO answer?
- Questions with an answer on a scale from 1-6?
- Questions with a short answer?

Creating a Brand	Producing a Logo
A brand includes a logo, messaging, packaging and product graphics and design. All of these have to work together.	Think about where might your logo be used: <ul style="list-style-type: none"> o On the product o On your marketing materials o On your social media pages o Anywhere else?
Think of your business brand as who you are and what you offer .	Think about what graphics and colours will express your personality
A brand is a name, symbol or any other feature that helps people to recognise you.	Create a tagline - a short statement that tells people who you are.



Think!

Although the Design Engineers, Managing Directors and Creative Directors are working on different activities, this session demonstrates the importance of communication between the teams, and where your different activities overlap.

- As the Design Engineers make different iterations of their product, they need feedback from their team on whether the design of the prototype reflects the vision, mission and values for the rest of the organisation.
 - o For example, if your vision, mission and values concern bringing your community together to use your system to access healthy food, is your system easy to use by everyone? Is it accessible for someone who has a disability?
- As the Managing Directors create a marketing campaign, have they liaised with the Creative Directors to ensure that all of their marketing materials have the same branding?
- As the Creative Directors choose their colours and graphics, have they worked with the Design Engineers to see if this can be incorporated into the design of the prototype system?



During today's session, you used your **Aiming High** skills.

You had to:

- Set a goal to do something that you might find challenging.
- Order and prioritise different tasks to help you achieve your goal.

One way of writing to goals is to make sure that they are SMART:

Specific
Measurable
Achievable
Realistic
Time-limited



To find out more about developing this skill, go to your [Skills Resources](#)

To learn more about SMART goals, watch [this video](#).



Reviewing your Business Activity

Creating a Display Board



When you pitch an idea to a group of people, you will often have a display board showcasing your work. The display board is important because it shows the journey that you have been on, which has resulted in the product or idea that you are presenting.

It is important to spend time organising your display board so that it is eye catching and informative, to draw people in to learn more about your company.

It is a good thing to include mistakes that you have made along the way, as this shows how you have learnt from them, and improved your work.

Making a Business Model Canvas

Earlier in the Challenge, you learnt about making a Business Model Canvas - a visual chart to explain why you have developed a product/concept, what it is, how you will finance it, what customers will benefit from your product, and how you will organise your company.

As you progress through a project, it is likely that you will need to update your Business Model Canvas based on what you have learnt. A significant step for your Business Model Canvas is **analysing your market research**. This means looking at the market research that you have completed, and understanding what the answers say. You need to read your Business Model Canvas before doing this, so that you remind yourself of what your company was set up to achieve in the first place, so that you know what you're looking for in the data.

Analysing your Market Research Data

Look at the questionnaires that you have collected. The answers that you have collected are your 'data'. Go through each question one by one and look at the data:

- Do people want to buy what you want to sell?
- Do you need to change anything?
- Record relevant information that you notice, for example '10 people out of 20 said that eating healthily was the most important issue for them'.
- Think about whether there is any word or idea that is being repeated a lot, for example, 'or 'the word 'sustainable' appeared 36 times in the data'
- See if you notice any other patterns, for example, do young people have different views on a topic to older generations?
- What do people like about your idea?
- What do people not like about your idea?

Now that you have analysed the market research, return to your Business Model Canvas and update it with your new understanding of who your customers are, and what they want.



Building your system

As you start to build your prototype aquaponic system, you will need to learn to make a frame using a saw and hammer and an irrigation system using pipes. Watch the videos below to find out more, and head to the [resources](#) section on the platform to find more videos.



[Constructing a Frame](#)



[Assembling an Irrigation System](#)

One of the most important things that you can do is to measure your metal tube and your pipes a few times before you cut them! Remember, you have only bought the materials that you can afford in your budget, so if you cut incorrectly it's going to be a hard issue to solve.

Look at your technical drawing. Get a few team members to join you and hold all of your materials in place, so that you can check that everything looks like it will fit together and work properly before you start to build.



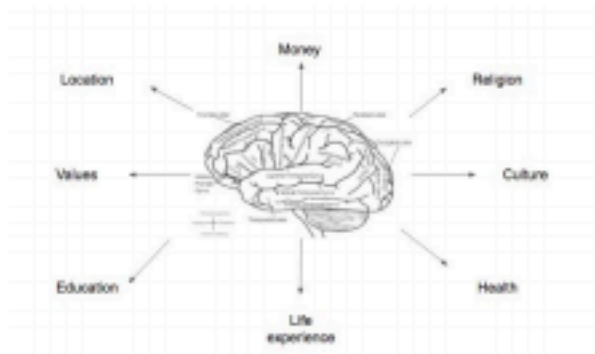
Think!

Why do people act the way they do?

As you analyse your market research you may be surprised by some of the answers that people give to your questions. There are many different factors that cause people to think and act the way that they do.

As you analyse your market research you should try to stay **open minded**, and to be **non-judgemental** - just because someone disagrees with you does not mean that you cannot find a common ground.

Make sure that you are thinking about why people think the way that they do and that your business is **inclusive** - that you think about the ways that your product may exclude certain groups and make steps to change that.





During today's session, you used your **Staying Positive** skills. This means that you use tactics to overcome setbacks and achieve your goals.



You may have had to:

- Make changes to your product if your customers did not like or understand aspects of it
- Change the way you planned to build your system if you realised that a part of it didn't work

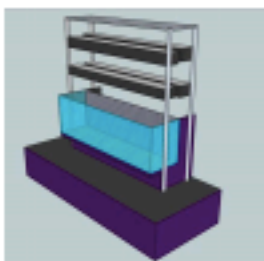
Or maybe there was another completely unexpected set back! How you respond to the challenge when things get difficult is very important.

To find out more about developing this skill, go to your [Skills Resources](#)

How to Present your Information in Different Forms

An important part of working in any career is being able to communicate your ideas. You could have the most amazing idea, but if you want it to benefit society, or if you want investment, you are going to need to be able to tell people about it! There are different methods of communication that you can use to be able to reach as many people as possible. Here are a few.

Design Rendering



Design rendering is the process of adding details to a drawing of your design to make it more realistic. This could include colour, texture, shading or any other details to try and convey how your product will look.

There are different ways that you can render your design on your computer. For example on PowerPoint or Google Slides, there are tools for you to use shapes to make a drawing. There is also Computer Aided Design software which you can use to draw your design, for example, 3D Builder or Blocks CAD.

Making an Academic Poster

An academic poster is used to explain a piece of research in a concise and visual way. Your Future Food Challenge academic poster will be slightly different from traditional ones: instead of explaining one piece of research, it will use all of the Produce Pod investigations that your team has carried out over the past few weeks. These are designed to show some of the most interesting aspects of an aquaponics system.



You need to look at each investigation and provide a short overview and a diagram of the results. You need to experiment with how to lay out your poster so that it is easy to understand, looks great and tells people about the most important parts of your research.

Creating an Infographic

An infographic is a visual representation of information or data. You are going to create an infographic to communicate your market research findings to the rest of your team, and to the public.



- You don't need to talk about everything** - pick out key questions and any interesting or surprising answers.
- Pick out the key figures** - did a large number of people answer a question in the same way, which shows a trend? Were any responses evenly split?
- Report both positive and negative findings.** You want to motivate the rest of the team, so suggest solutions for any negative findings. Is it possible to change anything?



Think!

As well as all of the tools for presenting your work outlined above, delivering a presentation in person is a very important skill. Presenting can be very scary - standing up in front of a group of people whether they are friends or strangers can be daunting. However the more that you practice, the better you will get, and the earlier you start practicing the better! You could even practice delivering a speech at home on your own, because you will feel more confident in what you are going to say in front of a group of people. Preparing clear notes, will also help to remind you of the points that you want to make.

When you are deciding who will deliver the presentation, take time thinking about who will take the lead in your team, or whether you each want to deliver a part of the presentation. Remember, just because some people are more talkative than others doesn't mean that they will make the best presenter - sometimes introverts have become some of the world's best public speakers!

For more advice on delivering a presentation visit [Skills Resources](#) on the online platform.

Developing Your Skills



You have now covered all of the eight key skills that we have been exploring. Each week, you have been developing all of these skills through the tasks that you have been completing. For more information on any of the skills visit [Skills Resources](#) on the platform. Also, use your skill and knowledge journeys on the platform to see which skills you are feeling the most confident in, and consider which you would like to develop further.



Get The Finance Right

In today's session, you started to learn about how to finance your startup business. You might be planning to sell your product (the prototype aquaponics system) or the produce (leafy greens, or another food you will experiment with in your Produce Pod). For your sales model, you need to explain what you will sell and how you will sell it.

Sales Model

To create your sales model - how you will sell your product - you will need to answer the following questions:

- 1) Are you selling a system, produce or both?
- 2) If you are selling a system, will the customer also be eating the food it produces?
- 3) Are you selling directly to the customer or through another business (e.g. shop, supermarket)?
- 4) Are there any other important features to explain about your sales model?



Costings and Investment

You will need to speak to other members of your team and find answers to the following questions:

- 1) Based on the hours worked by each team, how much salary will you pay per year? Work out hourly, daily, weekly and monthly rates first if this helps. Managing Directors will most likely also have the responsibility of carrying out your sales strategy.
- 2) How much in materials does it cost to build one system? How many systems do you aim to build in a year?
- 3) How much does it cost to run a marketing campaign? How many marketing campaigns do you aim to run in one year?
- 4) Are there any other costs that you need to include?
- 5) How much will you sell each system for? How much profit will you make?
 - i) Per system?
 - ii) Per year?



Investment

You need to decide if you are going to ask for any investment for your business. This will give an investor partial control of your company and a share of the profits. You might not want any, but you'll have to explain how else you are going to succeed on your own. You need to think about:

- 1) How much investment do you want?
- 2) What will you spend it on?
- 3) How long will it take an investor to make back their money?
- 4) What percentage of your company will you give away in return for investment?





Think!

A Social Enterprise is a business that has been set up to benefit people - it is not about making a lot of profit to earn money for managers, but instead profit can be reinvested back into the company to do more good work, or donated to another good cause.

It can be difficult to run a social enterprise, or any business, as there are so many different things to consider. There are international and national rules for how you must run your business that you have to follow. You want to make sure that your team is happy and healthy, and earn enough money. You want to make sure that your business practices are ethical for people and the planet. This means that you have to make sure that people who you are buying products from are treating their employees fairly, and that you are using as many eco-friendly products as you can.

Often, it would be easier and cost less money to conduct your business in a way that harms people and the planet, which is what many businesses and big industries do. However, by making choices that seem simpler now, often this doesn't reflect the true cost to other people and the planet. Always make sure that you are trying your best to be ethical, transparent and innovative to find the best way to help all people and the environment. Many social enterprises thrive, because their employees are doing something that they are very passionate about, which makes a massive difference.

Developing Your Skills



You have now covered all of the eight key skills that we have been exploring. Each week, you have been developing all of these skills through the tasks that you have been completing. For more information on any of the skills visit [Skills Resources](#) on the platform. Also, use your skills and knowledge journeys on the platform to see which skills you are feeling the most confident in, and consider which you would like to develop further.



Finishing Your Project

Planning for the Competition

The last two sessions are mainly about finishing off all of your work - you have managed to complete a lot of tasks so far! It is important to check where all of your teammates are up to with their tasks, and then give them a hand if you are finished and they are not.

Hopefully, everything has gone according to plan for you, but some things might have gone wrong. This week you will need to **problem solve** to finish the tasks that aren't yet ready. With hard work, and getting some of your teammates to help on a task, you could get all of your tasks finished on time. However, if it has become impossible for you to finish a task, for example, something has gone majorly wrong when building your prototype aquaponic system, you will need to be **creative** to decide what you are going to do about it in time for the competition.

Remember that a really important part of trying something new is getting things wrong. You will not be able to do everything perfectly when you are innovating. The important thing to consider in the future, and to demonstrate to the judges at the competition, is that you have learnt from your mistakes and have tried to turn a challenge into an opportunity.

Planning Your Presentation

In your **Skills Resources** you will find advice on **writing your presentation**. You might also want to look at some other presentations and watch different presentation styles. Click on the links below to watch these videos:



Why youth participation is
key



Science is for everyone, kids
included



Award-winning teenage
science in action

Ask yourself the following questions:

- 1) Who is your favourite speaker and why?
- 2) What are the differences in their speaking styles?
- 3) How do they use technology? Does it help to make their points clear?
- 4) Did you lose interest or stop listening? Can you think of why this happened?
- 5) What aspects of their talk would you like to replicate?
- 6) What style of speaking do you think would suit you the best? Funny? Personable? Formal?



Think!

It can be overwhelming hearing about other people's achievements, because we can get lost in comparison - you might see what someone else has accomplished and think 'I'll never be able to do anything like that!'. Hopefully you will have seen during the Future Food Challenge that your team needed a variety of different skills to complete the many different tasks. In the videos above, each of the speakers had different experiences which led to their discoveries or their activism. Remember, only you have had all of the experiences that you have had. No matter how 'normal' you feel your experiences have been, who knows what they might equip you for?

If there is a question that you are passionate about finding the answer to, think about how you might start.

Developing Your Skills



You have now covered all of the eight key skills that we have been exploring. Each week, you have been developing all of these skills through the tasks that you have been completing. For more information on any of the skills visit [Skills Resources](#) on the platform. Also, use your skills and knowledge journeys on the platform to see which skills you are feeling the most confident in, and consider which you would like to develop further.



What next?

You've done it!

Congratulations on reaching the final week of the Future Food Challenge! You now have a couple of weeks to finish off any tasks before the competition, but there will be no more new sessions. You may not have known anything about aquaponics a few months ago, but now you have built your own prototype system, as well as developing a startup business!

At the beginning of the programme you did a mind map to capture all of the things you knew about aquaponics. Go back to your profile on the platform, and add all of the information that you know now to your mind map in a different colour to show how much information you now know around this subject.

You can also use your knowledge journey tool to look at how confident you are in each subject area compared to at the beginning.



What next?

We have explored lots of different ideas throughout the Future Food Challenge and there may be an aspect of the project that has really sparked your interest. It doesn't stop here! There is work to do and future problems to solve. Here are some ideas about where to go from here:

- > **Raise awareness:** As you have seen throughout the Future Food Challenge, many people do not know about the impact of agriculture on climate change, or the possibility of using urban farming to help. You might feel that you're just one person, but if you tell your family, who tell their friends, who tell their families - that is how a movement starts. Before anyone can change their behaviour to help the planet, they need to be made aware of what the problems are.
- > **Learn more:** We have only covered one aspect of reducing our carbon footprint - agriculture. Use your researching skills to find out more about potential solutions to lowering our carbon usage, as well as other issues affecting our environment. When you are well informed, you can make decisions about your own behaviour, and learn how your choices affect the environment.
- > **Lower your own carbon footprint:** You could start implementing some of the practices that you have learnt during the Future Food Challenge such as building your own aquaponics system. You could think about other things you personally might be able to do to reduce your carbon footprint and be healthier.



- > **Get to know your local council:** In 2019, many councils declared a climate emergency. This means that each council has made a plan to combat climate change, for example, 'we will be zero carbon by 2030'. Find out what your local council is doing about climate change, and whether they are sticking to their promises, you think that there is an important part missing from the plans, or if you have any other ideas to help your city.
- > **Join with like-minded people:** Find out what is happening in your local area - there may be youth-led climate strikes, groups who organise different campaigns in your area, beekeepers and more. If you don't think that there is a group of people addressing the problems in your area, start a group yourself! You can use the skills that you have learnt during the Future Food Challenge.
- > **Follow Farm Urban on social media:** You can keep in touch with us about what you've been doing and find out about what we're working on next!



@greens.for.good



/greens.for.good



Think!

Here is a recap of what you have completed during the programme:



Developing Your Skills

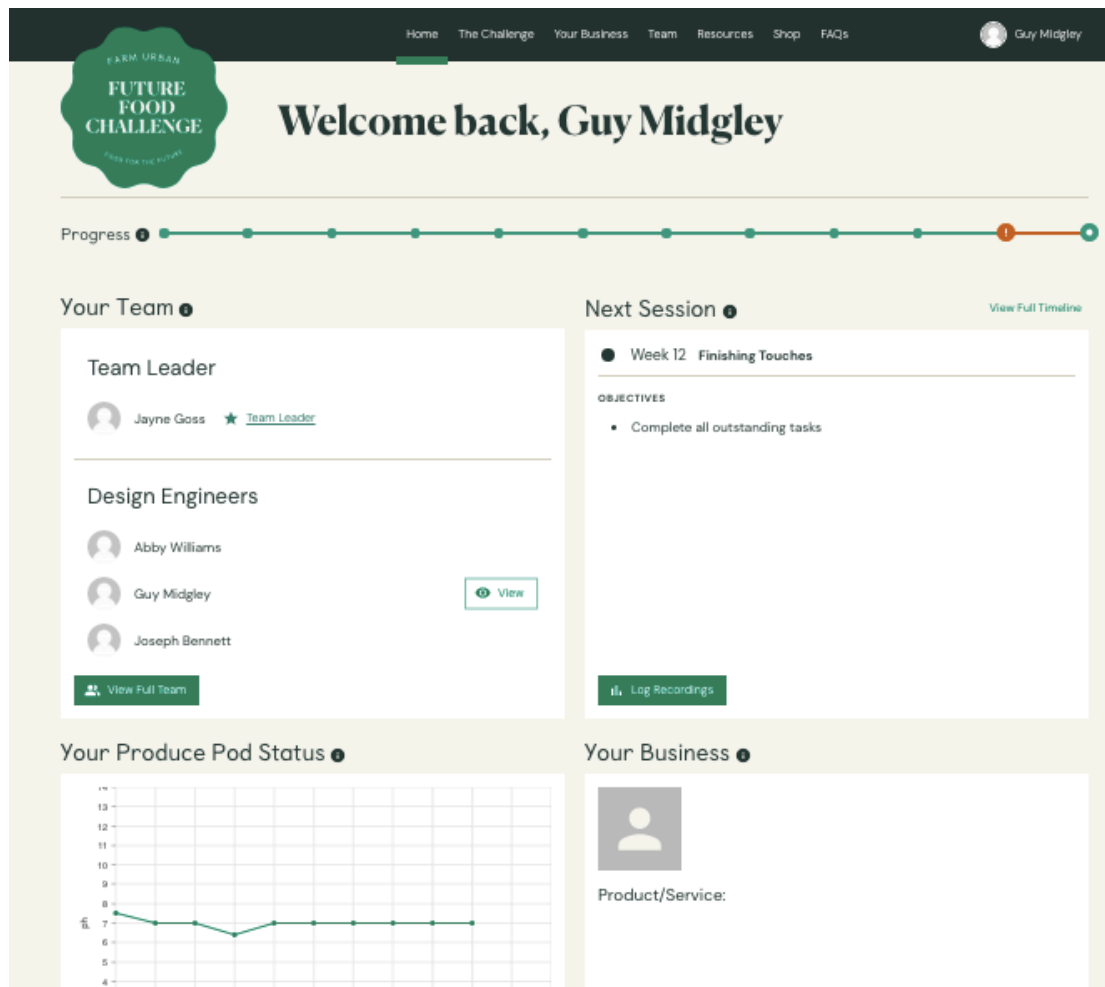
You have now covered all of the eight key skills that we have been exploring. Visit [Skills Resources](#) on the platform to recap any of the skills. Return to your Skills Journey on your profile and update your confidence levels. Remember, the skills you have been developing apply across any area. In other classes and projects, think about how you can develop your skills further, and continue to use your skills passports to move up to the next level.

Appendix 11 – the EcoVerse EdTech tool

The homepage for the EcoVerse platform provides information about the programme, EcoVerse's mission, and a link to more resources and information. It is envisaged that this page will feature as a brochure site, featuring demos of lessons and content for people who are considering using the programme to utilise. The brochure site will provide some free resources to explain the concepts behind the content hosted on the platform.

The image displays two screenshots of the EcoVerse Future Food Challenge website. The top screenshot shows the homepage with a green header, a navigation bar (Home, About, Login), and a main heading 'Welcome to Farm Urban's Future Food Challenge'. Below this is a subheading 'Uncovering the next generation of Scientists, Entrepreneurs and Leaders'. A paragraph states: 'Teams of students form their own startups to take on the challenge of getting aquaponic food growing into their town or city.' Four icons represent different aspects: 'Develop cutting edge science skills', 'Discover urban farming - the future of food in cities', 'Cultivate a whole new level of creativity', and 'Do start-up and enterprise differently'. A call to action says 'Read more about the programme and get in touch if you'd like to learn more.' The bottom screenshot shows a 'Facilitator' view with a navigation bar (Home, Facilitator, The Challenge, Your Business, Team, Resources, Shop, FAQs, FarmUrban). The heading is 'Welcome to the Future Food Challenge'. It includes sections for 'Getting Started' (Programme Overview, Student Evaluation Tools), 'Current Week' (with a session number input field set to 12 and a 'Save' button), 'What makes this programme different?' (describing the student-led nature and support), and 'Useful Links' (The Challenge, Team, Resources).

Facilitators of the programme have different permissions on the platform, including access to their own resource section, the ability to unlock future content for project participants and guidance for facilitating the programme and assessing participant progress. As the EcoVerse platform develops further, this section will host further Continuing Professional Development resources.



Teams are welcomed to the platform via the dashboard, which contains important information at a glance, including who is Team Leader for the week and the business profile, which will be populated by a business logo and tagline as well as the vision, mission and values of the team. The progress timeline indicates completed and non-completed sessions and highlighted outstanding tasks. The next session prepares students for what will be the upcoming requirements of the team. Finally the Produce Pod status shows the recorded results from the Produce Pod investigations undertaken by the students. As Farm Urban has previously partnered with Daresbury Laboratories to provide an educational programme, which incorporated sensors into hydroponic systems, it is envisaged that the platform will develop to incorporate similar industry 4.0 technologies.

Your Team

View your team below.

At the end of each session choose a Team Leader for the following session. The Team Leader will have additional instructions to make sure that everything is covered. The Team Leader will:

- Guide the team through information and tasks
- Ensure objectives are met
- Keep things running on time

In Session 3 you will be asked to choose your preferred role and can view roles here from Session 5 onwards.

Read more about the team roles in the [Resources](#) section.

Team Leader

Jayne Goss ★ [Team Leader](#)

Design Engineers

Abby Williams
Guy Midgley
Joseph Bennett

[View](#)

Creative Director


Abi Blackburn
Jens Thomas

The team page allows the facilitator to select roles for each team member as well as the team leader. In 'The Challenge' section of the platform, each week the nominated team leader is able to find resources to help them develop their leadership skills, and direct them through what they are required to do to lead each stage of the session. When the facilitator selects the team leader on the team page, the team leader will be able to view the resources relevant to them on 'The Challenge' page, whilst other project participants cannot.

The Challenge Sessions

Click on each session below for a summary of activities, key objectives and a list of what you'll need.

IMPORTANT: Ensure that you accurately tick any completed tasks under objectives. The team will be alerted to any incomplete tasks in the timeline on the business dashboard. This will help you to keep track of any outstanding tasks and manage your workload over the course of the programme.


Week 1 The science of aquaponics


SUMMARY
 Session one will provide you with an overview of the programme as well as practical experience of building your own functional Produce Pod. The activities during this session will develop skills in *Listening*.


OBJECTIVES
☒ Understand the biochemistry of aquaponics
☒ Build your Produce Pod
☒ Test the water in your Produce Pod and record the results
☒ Propagate seeds
☒ Communicate with Farm Urban and other schools via Slack

RESOURCES
[View Slides](#)
[Produce Pod Activity](#)
[Session Summary](#)

REQUIRED ITEMS

- One computer/laptop and projector
- Your ready-to-assemble Produce Pod kit
- 2 water dipstick test kits (6-in-1 and Ammonia)
- Access to water and an electrical socket
- Sunlight
- Seeds and Propagation Trays

 Weekly Uploads and Produce Pod Measurements

 Session Complete


Week 2 The tech behind aquaponics


Week 3 Starting a movement


Week 4 Design your business concept


Week 5 Starting up

The Challenge section is where participants are able to find session content week by week. This includes:

- Session overview.
- Session objectives for students to complete and tick off.
- Required items for the session.
- Document uploads to complete.
- Slides providing subject content for each session topic and activities for participant to complete.
- Teacher crib sheets.
- Team leader crib sheets.
- Produce Pod activities.
- Session summaries.

Once all of the objectives are met, the team leader can mark the session as complete, and the team are ready to move on to the next session.

Graphics

You might also want to create some other graphics that help people to identify your brand.

Think about the graphic on the first page for each session. It contains an image that Farm Urban uses a lot to help people recognise and understand our brand.



It shows that we're all about our city, Liverpool. It shows us growing food all over the city. The style links to the style of our logo so that they complement each other and help people to easily recognise us.

What is a brand?

A brand is a name, symbol or any other feature that helps people to recognise you.

Think of your business brand as **who you are** and **what you offer**.



A brand includes a logo, messaging, packaging and product graphics and design.

All of these have to work together.



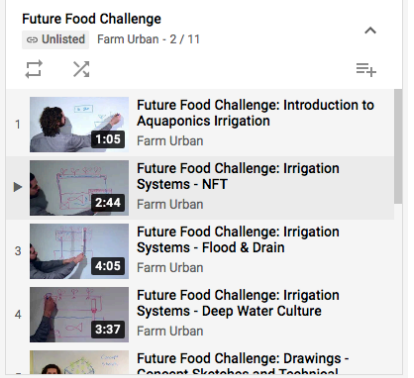
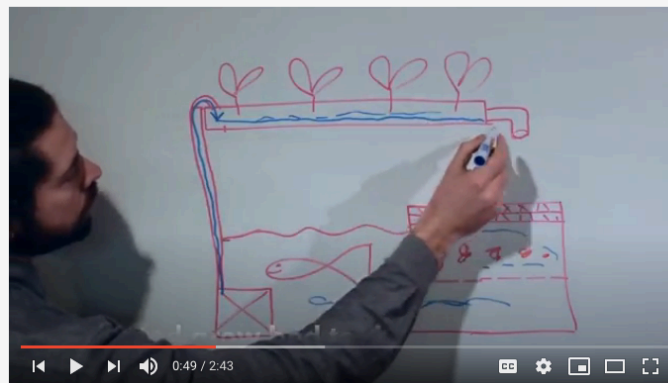
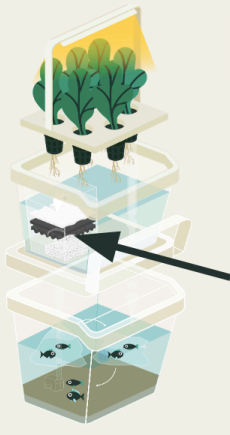
Do you remember where in the Produce Pod the bacteria live?

The bacteria need a substrate to live on. A substrate is a surface or material that grow on or from.

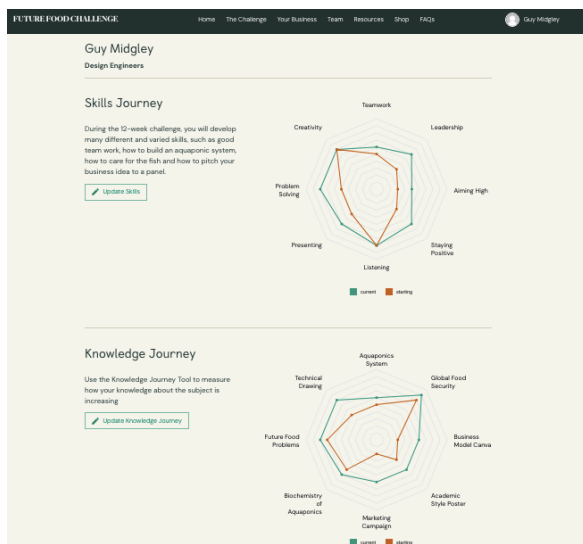
In the Produce Pod, they live and grow on the plastic media kept in the filter box, creating the biofilter.

biofilter

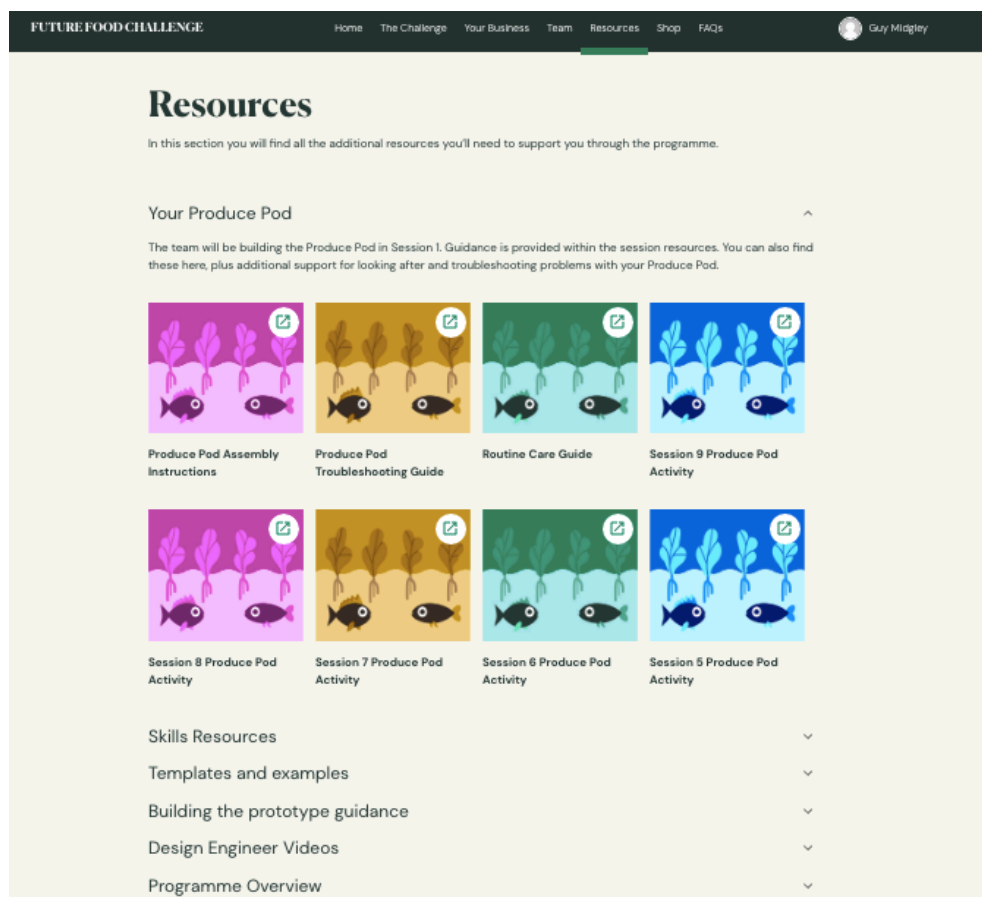
(There is the solid media)



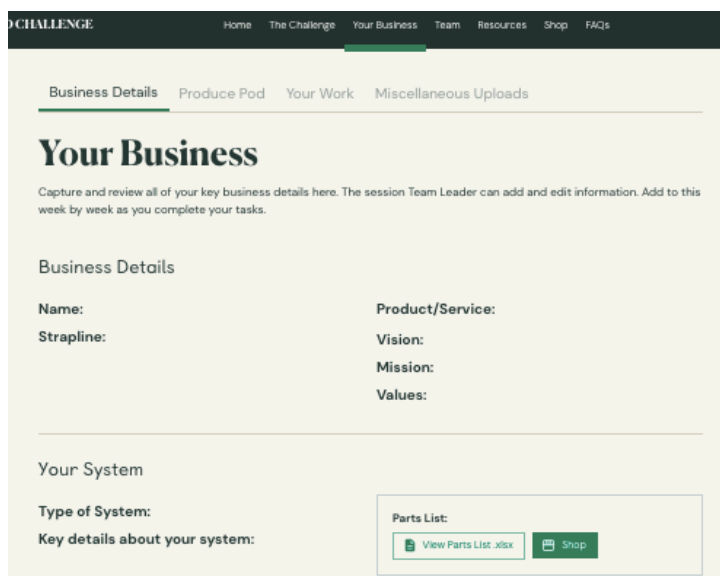
The slideshows provided for each session teach the team about sustainable agriculture, aquaponics and social enterprise in the first few weeks of the programme, and then become more specific for each business role within the team: managing directors, creative directors and design engineers. Farm Urban have developed 53 slideshows for use by the team during the programme, allowing a vast amount of information to be gained by project participants. After the team members adopt their different business roles, the sessions provide opportunities for sub-teams to share their work, so that the whole team can benefit from learning about the different aspects of the programme.



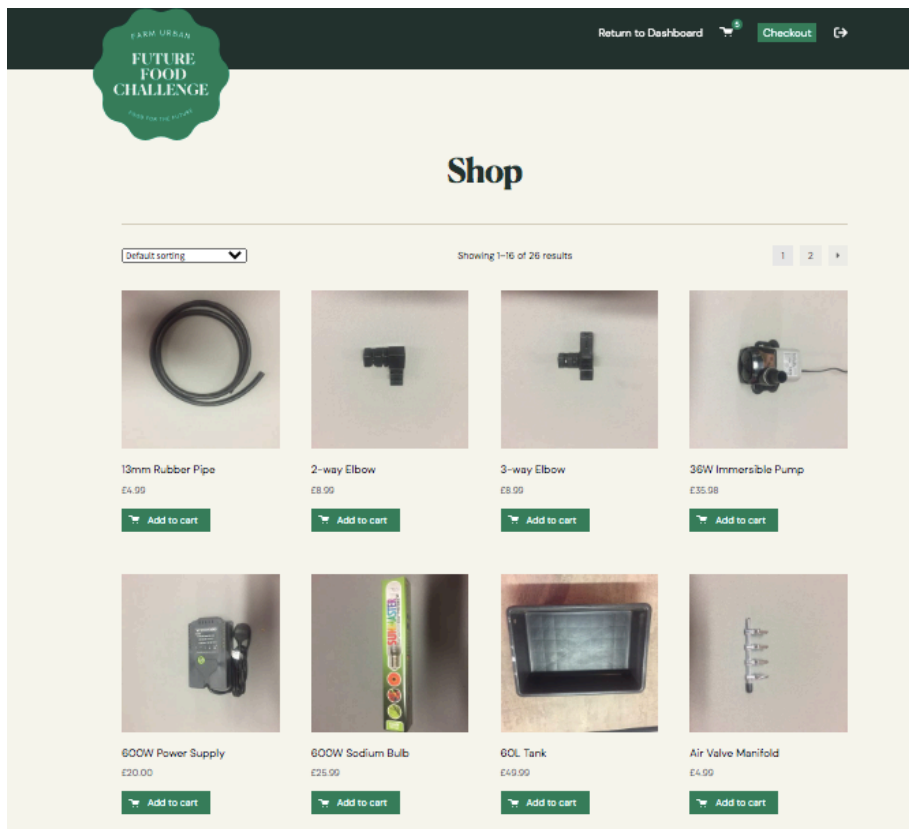
The participants have individual logins and are therefore able to use their own profile. In the 'your profile' section, students are able to select numerically how confident they feel in areas of skill and knowledge development so that they can monitor their progress throughout the programme. In order to help the students develop their confidence in self-evaluation, skills passports developed by Skillsbuilder Partnership are provided, which give students examples of skill development suitable for their age.



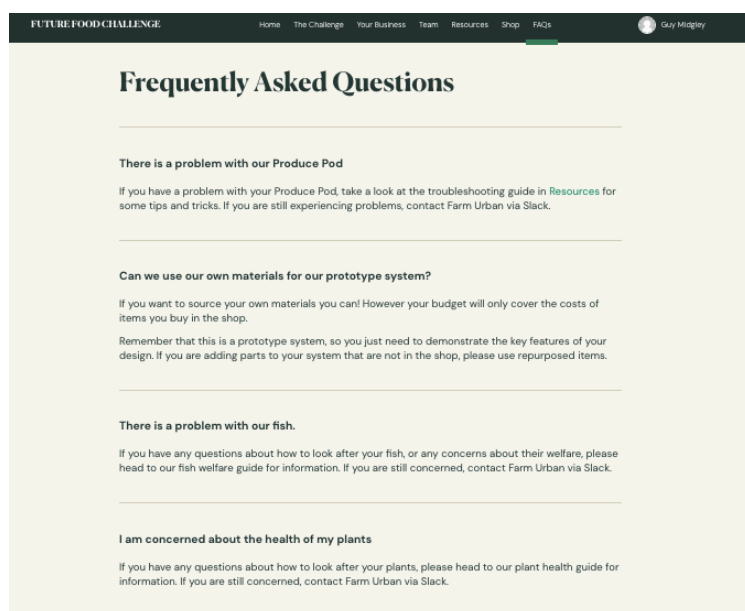
There is a resource section for students for additional support and personal development through the programme. This includes 54 resources, such as the aforementioned skills passports, videos and documents are available. Before students had an individual profile, there was not enough time during the programme to explore the concepts in the additional resources, however individual profiles have provided the scope for students to use additional material as little or as much as they wish outside of the sessions. When further funding is obtained for the future development of the platform, it is planned that the platform will move away from the slide and resource content as it is currently displayed, and students will navigate through a more interactive storyline exploring the concepts. This may include more videos and animation, however there is good scope for the platform to incorporate features such as augmented or virtual reality.



In the 'Your Business' section, students are able to make a profile, encompassing their logo, as well as mission and values statements, and a summary of their system design. Team members can upload and save their work here, and the section is highlighted on the main dashboard to help students to keep their company's mission in mind as they progress through the programme.



To build their prototype aquaponics system, students ‘buy’ resources from Farm Urban, that are provided to each school as part of the programme. As the Design Engineers complete a technical drawing of their design, alongside the Managing Directors, they are provided with advice to create a budget plan. Students can use the shop and their technical drawings to establish if their design is achievable within budget. Once they have finalised their design, students can order the parts required for their prototype through the Farm Urban shop.



Through correspondence with the teachers and students in earlier Future Food Challenges, Farm Urban has built a list of frequently asked questions. With further development of the platform, this will become a self-generating FAQ system, by utilising the data gathered by Farm Urban.